ARCHIVES OF

OTOLARYNGOLOGY

EDITORIAL BOARD

GEORGE M. COATES, Chief Editor, Philadelphia

ISIDORE FRIESNER, New York — CHEVALIER JACKSON, Philadelphia

RALPH A. FENTON, Portland, Ore. — JOHN F. BARNHILL, Miami Beach, Fla.

W. P. WHERRY, Omaha

VOLUME 25

1937

PUBLISHERS
AMERICAN MEDICAL ASSOCIATION
CHICAGO, ILL.

CONTENTS OF VOLUME 25

JANUARY 1937. NUMBER 1

PAGE

Osteomyelitis of the Sphenoid Bone: A Report of Two Cases. Lawrence James Lawson, M.D., Evanston, Ill. ... 1

Tuberculosis of the Petrous Apex: Report of a Case. Eugen Grabscheid, Vienna, Austria. Translated by Paul A. Campbell, M.D., Chicago ... 11

Pseudocerebellar Abscess. S. L. Shapiro, M.D., Chicago ... 17

Observations on the Larynx in the Tuberculous. Franklin P. Schuster, M.D., El Paso, Texas ... 23

Masked Sinusitis as a Cause of Obscure Fever. Arthur R. Sohval, M.D., and Max L. Som, M.D., New York ... 37

Otitic Meningitis with Recovery. Sylvio A. Sciarretta, M.D., Chicago ... 48

Cerebrospinal Rhinorrhea. David H. Ballon, M.D., and H. C. Ballon, M.D., Montreal, Canada ... 57

Neuro-Otologic Studies in Epilepsy. Edwin J. Blonder, M.D., Chicago ... 63

Recovery from Abscess of the Frontal Lobe Secondary to Empyema of the Sphenoid Sinus. Abraham Kaplan, M.D., New York ... 66

Effects on the Throat and Conjunctiva of the Hygroscopic Agent Used in Cigarets. Howard C. Ballenger, M.D., and V. H. Johnson, B.S., Chicago 75

Clinical Notes:

Twice a Host to a Bronchial Foreign Body. Charles Plume Schenck, M.D., Fort Worth, Texas ... 81

A Simple Test of the Explosibility of the Atmosphere Overlying the Operative Field Where Diathermy or Actual Cautery Is to Be Used. Paluel J. Flagg, M.D., New York ... 83

An Apparatus for Displacement Irrigation of Nasal Sinuses. Raphael Schillinger, M.D., Brooklyn ... 84

Progress in Otolaryngology. Summaries of the Bibliographic Material Available in the Field of Otolaryngology:

Functional Examination of Hearing. Robert Sonnenschein, M.D., and Norman Leshin, M.D., Chicago ... 87

Abstracts from Current Literature ... 102

Society Transactions:

Chicago Laryngological and Otological Society ... 110

Book Reviews ... 117

Directory of Otolaryngologic Societies ... 118

FEBRUARY 1937. NUMBER 2

Use of Sulfur Dioxide in Treatment of the Epidemic Cold. A. G. Rawlins, M.D., San Francisco ... 119

A Statistical Study of Allergic (Vasomotor) Rhinitis. J. A. Clarke Jr., M.D., and Harry L. Rogers, M.D., Philadelphia ... 124

Pathologic Change in Olfactory Nasal Mucosa of Albino Rats with "Stunted" Olfactory Bulbs. C. G. Smith, M.D., Toronto, Canada ... 131

Complete Apicectomy (Mastoidotympanoapicectomy): A New Technic for the Complete Exenteration of the Apical Carotid Portion of the Petrous Pyramid. Julius Lempert, M.D., New York ... 144

Treatment of Tinnitus Aurium by the Intravenous Use of Local Anesthetic Agents. Robert B. Lewy, M.D., Chicago ... 178

Thrombosis of the Sigmoid Sinus: A Clinical Analysis. J. H. Maxwell, M.D., Ann Arbor, Mich. ... 184

FEBRUARY—*Continued*

PAGE

Experimental Evidence for a Basic Theory of Vibrotactile Interpretation of Speech. Robert H. Gault, Ph.D., and Louis D. Goodfellow, Ph.D., Evanston, Ill. ... 190

Spreading Osteomyelitis of the Frontal Bone Secondary to Disease of the Frontal Sinus, with a Preliminary Report as to Bacteriology and Specific Treatment. Henry L. Williams, M.D., and Fordyce R. Heilman, M.D., Rochester, Minn. ... 196

Clinical Notes:

An Operation for the Correction of Atresia or Stenosis of the Anterior Nares. Gerald Brown O'Connor, M.D., San Francisco ... 208

A Glareless Ear Speculum. Louis K. Pitman, M.D., New York ... 210

Heating Pad for the Head and Adnexa. Noah Fox, M.D., Chicago ... 212

News and Comment ... 213

Abstracts from Current Literature ... 214

Society Transactions:

American Laryngological, Rhinological and Otological Society ... 222

Book Reviews ... 233

Directory of Otolaryngologic Societies ... 234

MARCH 1937. NUMBER 3

Surgical Repair of the Facial Nerve. Sterling Bunnell, M.D., San Francisco. 235

Diphtheria Simulating Peritonsillar Abscess: Dangers of Incision. A. Harry Neffson, M.D., New York, and Jacob Brem, M.D., Boston ... 260

Otitic Streptococcic Meningitis with Recovery: Report of a Case. S. P. Schechter, M.D., New York ... 266

Osteomyelitis of the Skull of Otitic and Paranasal Sinus Origin. Herbert C. Behrens, M.D., Whittier, Calif. ... 272

Use of the Galvanic Current in the Treatment of Atrophic Rhinitis and Ozena: Further Observations. Joseph S. Stovin, M.D., New York ... 305

Clinical Notes:

New Improvement for Diagnostic Illuminating Instruments. Louis K. Pitman, M.D., New York ... 308

Fragilitas Ossium with Otosclerosis and Blue Sclera: Report of a Case. Albert A. Cinelli, M.D., New York ... 309

Streptococcic Otitic Meningitis with Recovery. Henry Dintenfass, M.D., Philadelphia ... 311

Progress in Otolaryngology. Summaries of the Bibliographic Material Available in the Field of Otolaryngology:

Peroral Endoscopy. Louis H. Clerf, M.D., Assisted by Daniel C. Baker Jr., M.D., Philadelphia ... 314

Editorial:

Dr. George E. Shambaugh ... 342

Abstracts from Current Literature ... 343

Society Transactions:

Chicago Laryngological and Otological Society ... 354

Book Reviews ... 361

Directory of Otolaryngologic Societies ... 362

APRIL 1937. NUMBER 4

Osteomyelitis of Frontal Bone Resulting from Extension of Suppuration of Frontal Sinus: Surgical Treatment. Alfred W. Adson, M.D., and Bert E. Hempstead, M.D., Rochester, Minn. ... 363

A Proposed Operation for Osteomyelitis of the Inferior Aspect of the Petrous Pyramid. Mervin C. Myerson, M.D., New York, and Ralph Blumberg, M.D., and H. W. Rubin, M.D., Brooklyn ... 373

APRIL—*Continued*

PAGE

Pulmonary Collapse Following Tonsillectomy Under Local Anesthesia: Report of a Case. Samuel Iglauer, M.D., Cincinnati 382

Laryngoptosis: Ptosis of the Larynx Due to Downward Displacement of the Hyoid Bone Resulting from Fibrosis and Shortening (Congenital Anomaly) of the Left Sternohyoid and Sternothyroid Muscles. Gabriel Tucker, M.D., Philadelphia 389

Treatment of Asthmatic Patients in Otolaryngologic Practice. Noah Fox, M.D., and John W. Harned, M.D., Chicago 393

Intratracheal Inhalation Anesthesia: A Review of Ten Years' Experience, with Special Reference to Its Field of Usefulness, Details of Technic and Objections Raised Against the Method. Paluel J. Flagg, M.D., New York 405

Bronchiectasis in Children, with Special Reference to Prevention. George B. Ferguson, M.D., Albuquerque, N. M. 430

Nasal Obstruction in the Adult: A Quantitative Study. H. J. Sternstein, M.D., Boston 442

Aberrant Goiter, with Report of an Instance of Intralaryngeal Thyroid Tumor. Henry B. Beeson, M.D., Racine, Wis. 449

Otitic Meningitis. Raphael Schillinger, M.D., Brooklyn 455

The Great Vessels in Deep Infection of the Neck. L. C. Boemer, M.D., St. Louis 465

Clinical Notes:

Bony Deposits in the Auricle. J. H. Childrey, M.D., San Francisco 473

Instruments for Use in Surgery of the Petrous Pyramid. M. C. Myerson, M.D., New York 474

An Operation to Repair Lateral Displacement of the Lower Border of the Septal Cartilage. Lyndon A. Peer, M.D., Newark, N. J. 475

Abstracts from Current Literature 478

Directory of Otolaryngologic Societies 486

MAY 1937. NUMBER 5

Prenatal and Postnatal Development and Form of Crypts of Human Palatine Tonsil. W. L. Minear, M.B., Ph.D.; L. B. Arey, Ph.D., and J. T. Milton, M.D., Chicago 487

Tonsillectomy as a Cure for Peritonsillar Abscess, with Case Reports. Forrest W. Merica, Lakewood, Ohio 520

Further Experiences with Suppuration of the Petrous Pyramid. Mervin C. Myerson, M.D., New York, and H. W. Rubin, M.D., Brooklyn 525

Mediastinitis: A Clinical Study with Practical Anatomic Considerations of the Neck and Mediastinum. A. C. Furstenberg, M.D., and Luis Yglesias, M.D., Ann Arbor, Mich. 539

Effect of the Short Wave Current on the Temperature of the Paranasal Sinuses. Harry Rosenwasser, M.D., and William Bierman, M.D., New York 555

Structural Alterations in the Petrous Portion of the Temporal Bone in Osteitis Deformans. Barry J. Anson, Ph.D., and J. Gordon Wilson, M.D., Chicago 560

Clinical Notes:

An Unusual Tumor Involving the Maxillary Antrum. Ben L. Bryant, M.D., Los Angeles 581

Elongated Styloid Processes: Report of Two Cases. Watt W. Eagle, M.D., Durham, N. C. 584

Abstracts from Current Literature 588

Directory of Otolaryngologic Societies 600

JUNE 1937. NUMBER 6

PAGE

Direct Versus Intermediate Pathways in Infections of the Mastoid. L. G. Hadjopoulos, M.D., and J. W. Bell, M.D., New York 601

Some Observations on the Management of Infections of the Blood Stream from Mastoiditis. Ralph A. Fenton, M.D., Portland, Ore 618

Grafts in the Round Window in the Treatment of Certain Types of Deafness. Walter Hughson, M.D., Abington, Pa 623

Otitic Hydrocephalus. Henry L. Williams, M.D., Rochester, Minn 632

Meningitis Due to the Type III Pneumococcus: Review of the Literature and Report of a Case of Otitic Origin with Recovery Following Radical Mastoidectomy and Labyrinthectomy. Charles H. Allman, M.D., Boston 653

Meningitis Due to the Type IV Pneumococcus, with Recovery: Report of a Case. Paul S. Mertins, M.D., and Paul S. Mertins Jr., M.D., Montgomery, Ala. 657

Thrombophlebitis of the Lateral Sinus: Observations in a Series of Twenty-Two Cases. Samuel D. Greenfield, M.D., Brooklyn 661

Contribution to Symptomatology of Foreign Bodies in the Air Passages. Prof. W. Jarosslawsky, Vinnitza, Ukraine, U. S. S. R 684

Esophagobronchial Fistula. Herman J. Moersch, M.D., and Herbert W. Schmidt, M.D., Rochester, Minn 689

Intradural Abscess Complicating Acute Mastoiditis with Subperiosteal Abscess in an Infant: Report of a Case. G. W. Olson, M.D., Fresno, Calif 693

Clinical Notes:

Tonsil Dissector and Pillar Retractor. Thomas F. Furlong Jr., M.D., Ardmore, Pa. 695

Correspondence 696

Osteomyelitis of the Petrous Pyramid. Robert L. Moorhead, M.D., Brooklyn 696

Abstracts from Current Literature 697

Society Transactions:

Chicago Laryngological and Otological Society 706

Book Reviews 717

Directory of Otolaryngologic Societies 718

General Index 719

ARCHIVES OF OTOLARYNGOLOGY
VOLUME 25 JANUARY 1937 NUMBER 1
COPYRIGHT, 1937, BY THE AMERICAN MEDICAL ASSOCIATION

OSTEOMYELITIS OF THE SPHENOID BONE

A REPORT OF TWO CASES

LAWRENCE JAMES LAWSON, M.D.
EVANSTON, ILL.

The ability of the sphenoid bone to defend itself usually prevents the onset of osteomyelitis and tends to limit extension when the bone is invaded. Consequently, a review of medical literature reveals few reported cases. Such cases as are reported appear chiefly in the literature of the last seven years and parallel the careful studies of disease in the base of the skull made by trained clinicians seeking to solve baffling clinical problems by further study of the pathologic anatomy of this region. Since osteomyelitis of the sphenoid bone occasionally occurs, physicians should be prepared to interpret its onset, recognize its symptoms and consider therapeutic possibilities. Insufficient knowledge of disease in this relatively inaccessible region, necropsy permits of restricted character and the actual relative rarity of the condition have contributed to the limitation of case reports.

Eagleton [1] commented on infection of the base of the sphenoid as follows:

> The pattern of the blood supply within the red bone marrow accounts for the unique reparative and specific protective properties of the sphenoid base. This property is possessed to a lesser extent by the petrous apices. This explains the rarity of sequestra in pyogenic lesions of the apex or sphenoid base. The metamorphosis from red into yellow fat marrow occurs in all red marrow containing bones except the sphenoid, the segmented portion of the occipital, the vertebrae, the ribs, and the os innominatum, whose spongious structure has a preponderance of red cellular bone marrow throughout life. The rapid metaplastic reconversion from yellow acellular fat marrow to red cellular bone marrow as evidenced with cancer, infection, or irritants, is an evidence of the tissue mechanism which red marrow containing bones possess for local control of infections.

Infection in the base of the skull either in the sphenoid or the petrous apex is usually true osteomyelitis; it is destructive in its course, and it requires a special therapeutic and prognostic point of view because of its particularly dangerous invasion of the blood spaces. Infection in the marrow spreads as phlebitis or periarteritic infection and establishes an

---

Read before the Chicago Laryngological and Otological Society, Nov. 2, 1936.

From the Department of Otolaryngology of the Evanston Hospital and Northwestern University.

1. Eagleton, Wells P.: Meningitis: Result of Disease of the Petrous Apex and Sphenoidal Basis, Surg., Gynec. & Obst. **60**:586-587 (Feb. 15) 1935.

obliterating vasculitis. This is especially true of invasions by pneumococcic or hemolytic streptococci.

Symptoms of suppuration of the sphenoid sinus may be vague. The most frequent symptoms are postnasal inflammation, pain between and behind the eyes radiating to the temporal regions and occiput and pain located deep below the center of the vertex. Lacrimation, photophobia, blepharospasm, transitory scotomas, anosmia or cacosmia may be present.

The transition from simple sinusitis to a diffuse osteomyelitic infection is characterized by symptoms of invasion of the blood stream, a chill or chilly feeling and often hyperesthesia or anesthesia of the homolateral cornea. Complications of osteomyelitis of the sphenoid bone are usually disastrous. The most frequent complications are basal meningitis and thrombosis of the cavernous sinus. Other complications are septicemia, abscess of the brain, encephalitis and intracranial hemorrhage. Erosion in the delicate roof of bone is frequent. Extension along thrombotic vessels to neighboring structures occurs.

Pickworth [2] submitted the idea that organisms demonstrated in the lining of the sphenoid sinus, in the bone and in the wall of the carotid artery represent inhibited streptococci, which actually grew in the sphenoid region, but that the high antibody content of the patient's blood prevents reversion of the particular organism to its virulent prototype. The reversion of the chronic form to the virulent form is, I believe, illustrated in my second case report. That organisms do actually exist in a viable state in infections of the bone is clinically recognized by surgeons who hesitate to open the site of a long-healed chronic infection for fear of setting up acute local infection or septicemia. Furthermore, there are macroscopic changes of the bone with chronic infections of the sinuses producing osteitis and exostosis.

Faulkner [3] stated that the results of an inflammatory process in bone depend on the density of the bone and the severity of the inflammation. The walls of the frontal and sphenoid sinuses may be subject to carious changes or may show necrosis of small areas. The bony walls of sinuses may undergo sclerotic changes from prolonged contact with diseased membranes, this being so marked at times as nearly to obliterate sinus cavities. Osteomyelitis of the frontal bone is relatively frequent, but osteomyelitis of the sphenoid bone is infrequent.

Kaufman and Hartmere [4] called attention to a case in which latent osteomyelitis of the sphenoid bone was reactivated by trauma. In the

2. Pickworth, F. A.: Organisms in Chronic Bone Infections, J. Laryng. & Otol. **50**:206-210 (March) 1935.

3. Faulkner, E. Ross, in Jackson, C., and Coates, G. M.: The Nose, Throat, and Ear and Their Diseases, Philadelphia, W. B. Saunders Company, 1929.

4. Kaufman, A., and Hartmere, S. J.: Latent Osteomyelitis of the Sphenoid Reactivated by Trauma with Death from Meningitis, Laryngoscope **44**:477-487 (June) 1934.

necropsy findings it was noted that the ethmoid and sphenoid sinuses bilaterally were full of pus and the lining membranes thick and brownish gray. When the dura in the region of the left gasserian ganglion was elevated, reddish brown purulent material was seen between it and the base of the dorsum sellae on the left. When the dura was stripped from the dorsum sellae, its anterior surface revealed irregular thickening from chronic osteomyelitis. This process extended through the dorsum and was continuous with pus in the left sphenoid sinus.

Blumenthal [5] reported an instance of osteomyelitis involving the greater wing of the sphenoid bone of a child 4 years old.

Flatau [6] reported a case of caries of the sphenoid sinus in a young girl with bilateral suppuration from the sphenoid sinus. The chief complaint was headache. Both sphenoid cells had been opened, with no relief. Necropsy revealed meningitis caused by caries of the sphenoid bone with spontaneous perforation into the cranium.

Leuch [7] reported the case of a patient 25 years old who had latent chronic sphenoiditis and became ill with fever and headaches after a blow on the head. The inciting organisms were apparently reactivated in the sphenoid bone, and the resulting invasion produced acute osteomyelitis, thrombosis of the cavernous sinus, meningitis and death after eighteen days. Necropsy revealed osteomyelitis of the sphenoid bone, abscess of the right frontal lobe, suppurative thrombosis of the cavernous sinus and basal meningitis.

Hesse [8] reviewed seven cases of osteomyelitis of the sphenoid bone. The first patient had exophthalmos on the left side, basal meningitis, empyema of the left cavernous sinus, solitary empyema of the left sphenoid sinus without involvement of other sinuses and osteomyelitis of the body of the left sphenoid bone. The second had empyema of the sphenoid cell without involvement of other sinuses, osteomyelitis of the body of the sphenoid and thrombosis of the cavernous sinus, which produced fatal septicemia. The third had empyema of all the sinuses, osteomyelitis of the body of the sphenoid and basal meningitis. In the fourth case osteomyelitis of the sphenoid bone developed after trauma. In cases 5 and 6 osteomyelitis of the body of the sphenoid developed secondarily by extension from suppuration of the tip of the petrous bone. In case 7 osteomyelitis of the body of the sphenoid developed by thrombotic extension from a parapharyngeal abscess.

---

5. Blumenthal, B.: Sphenoid Osteomyelitis: Case Report, Ztschr. f. Laryng., Rhin., Otol. **17**:335-337 (Jan.) 1929.

6. Flatau, T. S.: Un caso di carie delle pareti del seno sphenoidale, Arch. ital di laryng. **13**:26-28, 1893.

7. Leuch, O.: Osteomyelitis Acuta des Os sphénoidale, Basel, L. B. Schwabe & Co., 1920.

8. Hesse, Walter: An Etiologic Study of Osteomyelitis of the Sphenoid: A Report of Seven Cases, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **137**:94-104, 1933.

Grant[9] expressed the belief that other sinuses frequently recover after severe influenzal infections, leaving involvement of the sphenoid sinus. His patient, aged 40, died from meningitis. On removal of the brain, the hypophysis remained in situ. It was dissected with difficulty and appeared edematous and injected. The sella turcica presented a brownish appearance, was softened and admitted a chisel with slight resistance. Purulent exudate escaped on exploration. The entire body of the sphenoid was involved, but the wings showed no structural changes. All other sinuses were clear.

I wish to report two cases of osteomyelitis of the sphenoid bone, one produced by extension from petrositis and one by reactivation of an old infection of the sphenoid sinus.

REPORT OF CASES

CASE 1.—G. I. B., aged 6 years, entered the hospital with scarlet fever and suppurating right cervical glands. Bilateral otitis media developed. Bilateral myringotomy was promptly done. Otorrhea continued for four weeks and increased. Both mastoid regions became involved, and both were operated on at the end of the fourth week, with the usual thorough technic. Fourteen days later he was dismissed as cured and was sent home. The temperature remained normal for two weeks; then fever recurred, as a low afternoon elevation of temperature. Mild otorrhea on the left side recurred, with a spot of moisture at the center of the left mastoid wound, diplopia from paralysis of the left external rectus muscle, headache on the left side and pain behind the left eye and over the left antrum, which transilluminated well and was free from demonstrable involvement. These symptoms were maintained for eight days. On the ninth day the temperature rose sharply and the patient was readmitted for further surgical care. The left perilabyrinthine cells were thoroughly cleaned out. The usual débris in the cavity of the middle ear was removed, and the peritubal cells were drained as well as possible. Forty-eight hours later typical basilar meningitis developed, and seventy-two hours later death occurred.

Pathologic Changes.—There was typical basilar meningitis. Soft pink granulation tissue caused adhesions between the dura and the body of the sphenoid bone on the left side. This extended centrally to involve the posterior portion of the sphenoid bone in the region of the posterior left quadrant of the body, there being complete softening of the posterior clinoid process and the body of the sphenoid adjacent to the apex of the left petrous pyramid. There was a deep jagged cleft at the medial extremity of the petrous portion of the temporal bone, extending laterally on both the posterior and the anterior surface and filled with thick yellow pus. This cleft was lined with tough pink granulation tissue.

CASE 2.—Mrs. E. R., aged 33, had suffered acute attacks of asthma for several years and had shown positive allergic reactions. One severe attack followed a shampoo with a preparation of orris root. She was not in robust health. She had been hospitalized for threatened miscarriage after six months of pregnancy and had spent three months in bed before delivery at term of a normal child. Laboratory findings were negative at that time. Fifty-two days later, after three days of sore throat, she was seized suddenly in the middle of the night with

9. Grant, A. L., Jr.: Acute Abscess of Sphenoid Sinus Rupturing into the Pituitary Fossa: Autopsy Report, Laryngoscope **41**: 842-844 (Dec.) 1931.

severe pain, which fluctuated between a carious right lower wisdom tooth, temporarily filled, and the right ear. At examination the right ear drum was bulging. A myringotomy was done. The opening made was entirely adequate, and drainage was profuse, but severe pain persisted, which required opiates. Two days later, there was some mental confusion (possibly from pentobarbital sodium), profuse serous discharge from the right ear, marked tenderness over the region of the antrum and the tip of the mastoid and numbness of the right side of the face and the nose. The pupils reacted normally. There were slight coarse nystagmoid movements, severe deep pain in the ear, sensation of objects turning toward the left and continuous bell sounds. A diagnosis of acute serous labyrinthitis on the right side was made.

The patient was hospitalized on the fourth day after myringotomy, which, while adequate, had failed to give the usual relief. There were still tenderness of the tip of the right mastoid and profuse drainage from the right ear. The symptoms at that time were those of acute congestive mastoiditis, with decreasing symptoms of labyrinthine irritation. The temperature on admission was 101.5 F., and the pulse rate was 120. The hemoglobin content was 77 per cent, the red

Fig. 1.—Osteomyelitis of the apex of the petrous bone, with extension to involve the body of the sphenoid bone.

cell count, 4,460,000 and the white cell count, 7,350. The roentgenologist reported an increase in density involving uniformly all cells of the right mastoid region, but no destruction by cell division. Culture of material from the ear gave gram-positive cocci in pairs and chains, green forming and slightly hemolytic. There were two days of excruciating pain in the ear. The nurse's record of the first two days included notes of sore throat, a roaring sound in the head, severe pain when the head dropped backward, a sensation of voices and ringing in the ear, severe pain behind the right ear and a feeling of numbness of the right side of the face. On the third day, the temperature receded to 98 F. and the pulse rate to 82; there was only slight pain on deep pressure over the region of the antrum and the tip of the mastoid, and the patient was allowed to return home.

Symptoms became milder, and the discharge continued variably for four and a half weeks. Then, because she did not gain strength and otorrhea was increasing, she was again hospitalized, with a temperature of 100.2 F. and a pulse rate of 110. New roentgenograms revealed the right temporal bone to be increased in density, with some dissolution of cell walls. A thorough mastoidectomy was done. There was extensive cell formation. Neither the dura nor the lateral sinus was involved.

Significant Postoperative Data: On the third postoperative day there were a roaring sound in the right ear, nausea, dizziness when the eyes were covered, headache and soreness of the left side of the throat.[10] On the fourth postoperative day the roaring continued in the right ear, the throat was still sore, the left side of the nose felt stuffy and she expectorated purulent mucus. On the fifth day the left nostril was blocked (all symptoms in the ear were on the right side). On the sixth day the left side of the face seemed more sensitive. All sinuses appeared clear on transillumination. On the seventh day there was an attack of asthma. Flowers were removed from the room. There was still some vertigo, and a slight roaring sound was heard in the right ear. On the eighth day all stitches were removed. On the ninth day there was severe pain about the left eye. On the tenth day the mastoid wound was in excellent condition, with slight drainage. On the eleventh day, being comfortable, with good appetite a temperature of 98 F. and a pulse rate of 78, she was dismissed.

Eight days later, a complete change came suddenly, with nausea, vomiting, chill, rigor, prostration, poor circulation and color and a stiff neck. Invasion of the meninges and the blood stream seemed evident. She was readmitted to the hospital. The cell count and pressure of the spinal fluid were normal. The knee jerks were brisk, but there was no Kernig sign. The plantar reflexes were normal, and the neck could be flexed. There was no nystagmus. Meningitis seemed improbable. With the left nasal chamber blocked and purulent discharge from the sinuses, infection of the sphenoid or the posterior ethmoid sinus had to be considered. Culture of material from the nose gave frequent colonies of green-forming streptococci. The red blood cell count was 4,950,000, the white cell count 14,750 and the hemoglobin content 83 per cent. The roentgenologist reported a slight increase in the density of the sphenoid sinuses.

On the second day there was a chill at midnight, revealing an invasion of the blood stream. Whether this originated from the right lateral sinus or its tributaries or from the veins around the left sphenoid sinus was not clear. The wound in the right mastoid was perfectly healed, and the middle ear was dry. On the fourth day there was a headache localizing around the left eye, the back of the neck and deep under the center of the vertex. It was apparent that extradural abscess with thrombophlebitis was probable, but it was uncertain whether this arose from the original infection situated in the right temporal bone or from the present active infection of the left sphenoid. The left sphenoid sinus was irrigated on the fifth day. On the sixth day the patient felt better and a second irrigation of the sinus was done, yielding mucopus. On the seventh day the third irrigation of the sinus was done, and on the eighth day a fourth, evacuating thick mucopus. Apparently there was an infective thrombophlebitis originating in the region of the left sphenoid, for with irrigation of the left sphenoid sinus four times (all symptoms were on the left side at that time) there was a coincidental rise in temperature which suggested the possibility of osteomyelitis of the body of the sphenoid with a small perforation of the roof.

On the tenth day there was another chill. The patient did not fuse objects well, although there was no true diplopia. The fundi were normal. On the eleventh day the left sphenoid sinus was opened by removal of the anterior wall. Cultures taken from it gave colonies of green-forming streptococci. This was followed by three days of normal temperature. On the fifteenth day a roentgen study

10. This date in review marks the first clinical evidence of reactivation of old infection in the left sphenoid sinus, which may have been a basis for previous attacks of asthma and responsible for the beginning of a whole new chain of symptoms.

was made to determine the extent of the pathologic condition of the sphenoid and to account for a stiff neck in the absence of abnormality of the spinal fluid. The cervical portion of the spine was normal. There was obvious pansinusitis on the left side. The neck had been stiff, but the stiffness was lateralized to the right side, so that by the twentieth day there was a reddened area low down on the neck posteriorly, with slight fluctuation. This was opened, and 2 cc. of pus was evacuated from deep in the tissues. This gave a pure culture of Streptococcus viridans and the opening drained profusely on the following day. On the twenty-fourth day a window was made in the left antrum. On the thirtieth day there was drainage of two posterior cervical abscesses. On the thirty-fifth day 100 cc. of convalescent Str. viridans serum was given intravenously. From the thirty-first to the thirty-sixth day, multiple openings were made on both sides of the neck for deep abscesses resulting from spreading suppurating posterior cervical thrombophlebitis. On the thirty-sixth day the right lateral sinus was exposed. It was soft and looked normal, but no blood came from it on aspiration. There was complete thrombophlebitis of the jugular bulb, with retrograde thrombosis of the right lateral sinus. Two days later, the jugular and facial veins were ligated, the openings of the various deep posterior cervical abscesses of both sides connected and Dakin tubes placed in these extensive dissections to the deep suppurations of the posterior cervical veins. The patient died on the fortieth day, with marked edema of the entire head from severe obstruction of venous circulation.

Besredka's antivirus (a bacterial filtrate),[11] convalescent serum, Ringer's solution with 5 per cent dextrose [12] given intravenously, feeding by gavage and repeated transfusions of whole blood were used in therapy.

Two blood cultures gave colonies of Str. viridans.

Necropsy Report.—No exudate was apparent over the base or the convexity of the skull. The dura lining the base of the skull was smooth and glistening. The right jugular bulb contained a firm lamellated brown thrombus tightly adherent to the lining but soft in the center. On the left side there was a thin mural thrombus in the jugular bulb, but the lumen was not seriously narrowed. When the dura was separated slightly from the bone around the right jugular vein, a large quantity of thick yellowish gray blood-streaked pus escaped, much of it apparently coming from the lower level of the neck. This perijugular abscess was continuous under the dura, with a similar abscess around the veins of the right cavernous sinus and the necrosed portion of the body of the sphenoid. The lamellae of bone between this abscess of the cavernous sinus and the sphenoid and posterior ethmoid sinuses were thin, soft and easily broken. When they were removed, a large quantity of thick, viscid, blood-streaked pus escaped from the sphenoid sinus and the posterior ethmoid sinuses. The lining of these sinuses was extremely thick, edematous and hyperemic. A similar suppurative process was found in the left maxillary sinus. Only the two anterior ethmoid cell regions and the right maxillary sinus seemed to be free from or only slightly involved

11. Besredka's antivirus is a bacterial antigen prepared from staphylococci, streptococci and colon bacilli by growing them in special broth until the products of metabolism are so concentrated that the growth of the bacteria is no longer possible. The culture is then filtered through a sterile Berkefeld filter to remove all bacteria. It is used subcutaneously, intradermally or as wet dressings to inhibit the growth of specific organisms.

12. The formula for the Ringer's solution with dextrose was 7 Gm. of sodium chloride, 0.25 Gm. of calcium chloride and 0.3 Gm. of potassium chloride, with 5 per cent (50 Gm.) of dextrose per liter.

in the infection. The left middle ear was normal. On the right side practically all the mastoid cells had been removed surgically, with normal healing. The lining of the cavity of the right middle ear had a slightly reddish brown discoloration and scanty secretion. The cancellous bone and the marrow of the tip of the petrous portion of the right temporal bone had a slight brownish discoloration as compared to the corresponding area on the opposite side.

Hypophysis: No appreciable alteration could be noted microscopically.

Lungs: There were multiple small emboli and thrombi with necrosis of the arterial walls and abscess formation. There were areas of hemorrhagic infarction and confluent embolic pneumonia. Surfaces made by section revealed small groups of recent abscesses in the right apex. A single abscess at the base of the right lung at the posterior diaphragmatic margin measured 2 cm. in diameter. In the upper part of the lower lobe of the left lung there was an area of consolidation about 6 cm. in diameter, containing several groups of small abscesses and blood

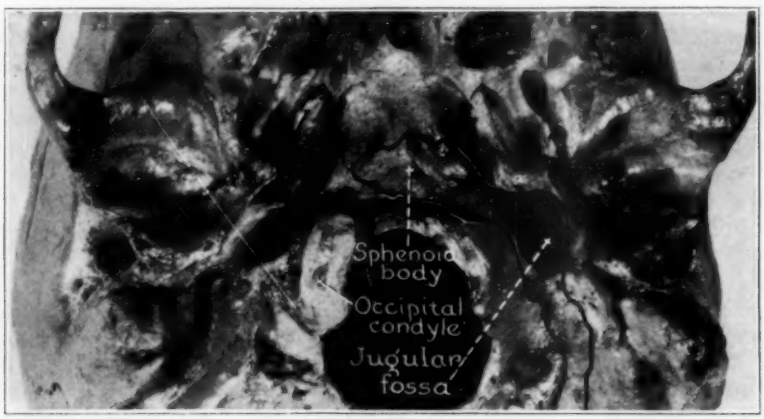

Fig. 2.—Osteomyelitis of the sphenoid bone. There was a continuous stream of pus from the abscess beneath the dura under the cavernous sinus and over the sphenoid body, down along the right jugular bulb and then posteriorly in the neck to connect with diffuse bilateral posterior deep cervical abscesses.

vessels filled with firm brown thrombi. Isolated small abscesses from 1 to 5 mm. in diameter were scattered throughout both lungs.

Summary.—The following conditions were present: suppurative ethmoiditis and sphenoiditis, and left maxillary sinusitis; osteomyelitis of the body and the right ala of the sphenoid bone; abscess in the region of the right cavernous sinus and dissecting abscess around the right jugular vein; mural thrombus of the left jugular vein; extensive cellulitis of the back of the neck and the posterior part of the scalp, and metastatic abscesses of both lungs.

COMMENT

Batson [13] stated that the main outflow from the jugular veins may be equaled or replaced by that from the mastoid or occipital emissaries. The pterygoid plexus communicates with the cavernous sinus and con-

13. Batson, Oscar V.: The Venous Circulation of the Head, Graduate Lecture, American Academy of Ophthalmology and Otolaryngology, 1935 (unpublished).

stitutes a large and important venous reservoir. The posterior condyloid veins are inconstant but when present, as they frequently have been in our series, may equal half the diameter of the jugular vein of the same side, and, with the vertebral plexus, may act as a by-pass around the jugular vein to the heart. These large posterior by-passes probably explain the inaccuracies in interpretation of the negative Tobey-Ayer reaction. In a series of specimens prepared by injecting a contrast substance into the external jugular vein of one side with the flow directed toward the head, all the venous sinuses of the head as well as both internal jugular veins were uniformly filled. These injections show the difficulties encountered in efforts to isolate various infected portions of the venous system, such as the sigmoid sinus or the jugular bulb. Furthermore, in another series of experiments, after isolation of the lateral portion of the transverse sinus, it was possible to inject a contrast substance into the internal jugular vein of the same side by putting a

Osteomyelitis of the Sphenoid Bone: A Study of Etiology in Thirteen Reported Cases

	No. of Cases
Trauma through chronically infected sphenoid sinuses	3
Directly following acute infection of the sphenoid sinus	2
Secondary to chronic suppuration of the sphenoid sinus	4
Extension from disease of the tip of the petrous bone	3
Extension by thrombosis from parapharyngeal abscess	1
Total	13

cannula into the sinus above the point of the ligature. Corrosion perforations of the entire head show that one might consider the head and neck to be a vast intercommunicating venous plexus in which the scalp, skull bones, brain, mucous membrane and other tissues are embedded. The bony barriers which are so real in surgical approaches are valueless in resisting the progress of infection by way of the veins.

SUMMARY AND CONCLUSIONS

In the first case there developed an unusual amount of destruction of the sphenoid body before diffuse fatal basal meningitis developed.

In the second case there developed neither meningitis nor thrombosis of the cavernous sinus, which are the more usual complications, but the process took the unusual outlet of posterior cervical thrombophlebitis, with abscess formation and late septicemia. There was a continuous stream of pus from the abscess beneath the dura under the cavernous sinus and over the sphenoid body, down along the right jugular bulb and then posteriorly in the neck to connect with diffuse bilateral posterior deep cervical abscesses. This condition, with the anterior cervical

spaces free from infection, is unique. The perfectly healed right mastoid wound and dry cavity of the middle ear, with all the pain, nasal obstruction and sinus infection through the earlier stages on the left side, presented a confusing symptom complex. The development of recurrent asthma with the onset of infection of the sphenoid suggests that previous disease of the sphenoid may have escaped notice and that its reactivation due to lowering of the patient's resistance by the mastoid infection

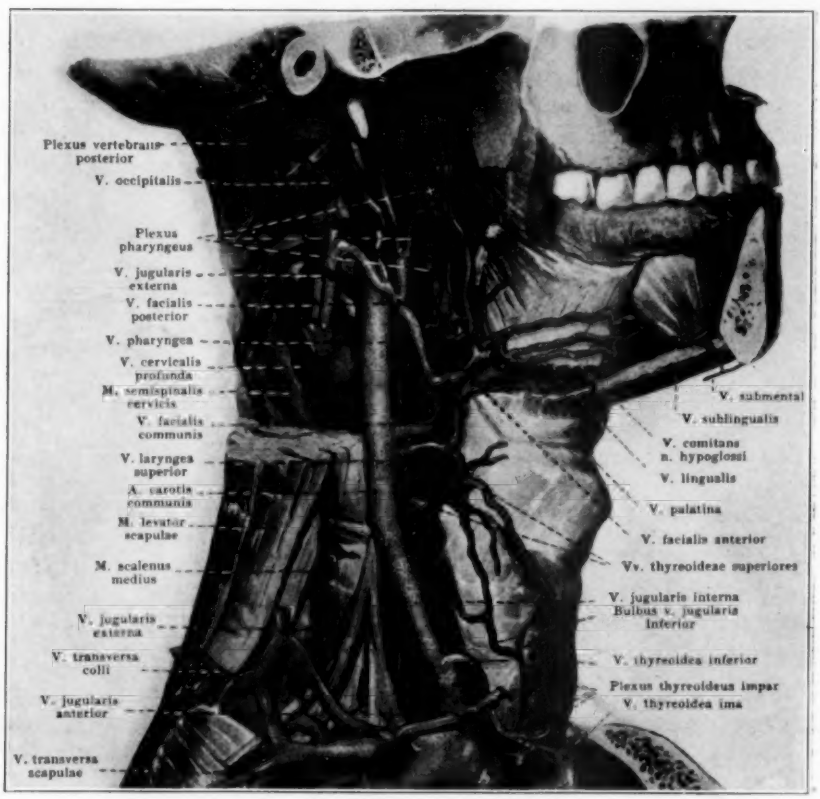

Fig. 3.—Drawing after Spalteholz to show the anatomy of the deep posterior cervical veins.

caused the unusual symptoms and overwhelming infection which followed.

Osteomyelitis of the sphenoid bone will not respond to drainage by steel drills. It requires extensive surgical removal of bone beyond infected thrombosed blood vessels as in other locations. This is not possible by any present day technic.

TUBERCULOSIS OF THE PETROUS APEX

REPORT OF A CASE

EUGEN GRABSCHEID

VIENNA, AUSTRIA

TRANSLATED BY PAUL A. CAMPBELL, M.D., CHICAGO

Of the various diseases of the apex of the petrous pyramid, those which extend from suppurative processes of the middle ear are by far the most frequent and the most important. A practical knowledge of the other diseases and disease processes is necessary, however, in order to understand better conditions in the apex of otogenic origin. Among these are the invasive processes from tumor of the gasserian ganglion and the auditory nerve. Tuberculosis of the petrous apex is still less frequent. In the clinics I recently have had opportunity to observe a case of tuberculosis, which will be described in detail in this paper. I feel that it is of interest, first, because of the rarity of the condition and, second, because it demonstrates the extension of a disease process through the petrous bone to the petrous apex.

REPORT OF CASE

The patient was a landlord, 37 years of age. His family history was without significance. He was unable to remember any of his childhood diseases and could not recall any unusual circumstances during his adult life. The first symptoms of the condition which I am about to describe appeared in November 1934, at which time he began to notice that he was more hoarse than usual and that he had difficulty in swallowing. Soon he found it so difficult to swallow that he was forced to take only liquid nourishment. About two months later he began to be bothered by ringing noises in his ears but had no trouble with his hearing. At that time pain was present on the left side of his face, particularly in the region of the left upper jaw. Dizziness then developed. He described this sensation by stating that objects seemed to turn around him while he himself was drawn to the right. Finally he began to have headaches in the left occipital region, which radiated to the left frontal region.

Neurologic Changes.—After a short time the patient was seen by Dr. H. Urban, who reported as follows:

The patient has difficulty in fixation, is easily bewildered, occasionally showing psychomotor irritability with evidence of a defect of intelligence. He is forgetful and finds it difficult to reckon. On examination the left pupil is markedly irregular. There is no reaction to light. Both fundi are hazy in their periphery. There is approximately 1.5 diopters of choking of the disks. The vision with correction

From the Pötzl Clinic of Neurology and Psychiatry of the University of Vienna and the Brunner Clinic of Ear, Nose and Throat of the Allgemeinen Poliklinik of Vienna.

is: right eye, 5/36; left, 5/12. The visual fields made by a rough test are essentially normal. There is possibly some lessened sensibility for pinpricks and temperature over the left half of the face. There is evident paresis in the second and third branches of the left facial nerve. The protruding tongue deviates to the left. Power is markedly decreased in the left hand. Sensibility of the tendons on the left side is decreased. Tonus and reflexes are increased on the right side but decreased on the left. When the finger is brought to the nose while the eyes are closed, there are some ataxia and past pointing to the left. When the Romberg reaction is tested, the patient immediately falls. In recovering balance his head wabbles in the characteristic manner. He is unable to walk with his eyes closed. When walking with his eyes open he has a staggering gait on a broad base with a constant deviation to the left. The Wassermann reaction of the serum is negative.

Examination of Ear, Nose and Throat.—On otoscopic examination the right drum membrane was essentialy normal and the left a grayish pink. The tip of the left mastoid process was tender to pressure, but no edema was present. On the right side the whispered voice was heard at a distance of 4 meters. On the left neither the spoken nor the whispered voice could be heard at all. The Stenger test gave unreliable results. Unilateral calorization failed to elicit excitability on either side. The turning test with ten turns to the right resulted in nystagmus to the left for eight seconds. Ten turns to the left gave nystagmus to the right for ten seconds. Symptoms of fistula were absent, and tests by aspiration and compression gave negative results on both sides.

Examination of the pharynx and larynx showed large quantities of mucus in the left pyriform sinus. Both the laryngeal and the pharyngeal reflexes were lessened in intensity. Movements of the vocal cords were normal.

On roentgenologic examination the skull appeared spacious but of less than average thickness. The structures appeared to be in normal relations. The digital impressions did not seem deepened. In the base of the skull, particularly in the region of the sella turcica, there was no definite evidence of pathologic change. In the region adjacent to the tip of the pyramid in the os basilare, however, there appeared to be a large, irregular but sharply limited area of decreased density. This area was thought probably to be a somewhat atypical anatomic variation in the course of the sinus. No endocranial calcification could be seen.

After consideration of the neurologic symptoms it may be noted here that the evidence pointed to a lesion in the left posterior cranial fossa in the region of the cerebellopontile angle. It was felt that it was probably a tumor extending toward the foramen jugulare and also to the region of the foramen occipitale magnum.

Operation.—On March 18, 1935, Professor Denk operated with the patient under local anesthesia. At the time of the operation the patient was completely unconscious, responding neither to conversation nor to pain. Two punctures of the ventricle were made, and 60 cc. of fluid was removed. This procedure failed to lessen the depth of the coma. As the pulse was small and frequent at that time, all hope for success of the operation was given up. As a measure of last resort a trephine operation was planned under the external occipital protuberance. At that time the pulse rate had risen to 160 beats per minute, and the systolic blood pressure had gone down to 50 mm. of mercury. By the use of stimulants the pulse rate was brought down to 140 and the systolic blood pressure up to 65. The encroachment was then risked.

With the patient face down, the skull was tapped to the right and to the left of the midline and on the left side above the external occipital protuberance.

Through this opening the dura was punctured, and about 20 cc. of fluid was withdrawn. When this amount was reached, the fluid ceased to run spontaneously. It was perfectly clear. The bone was then removed down to the sinus sigmoideus and the sinus transversus on both sides. The posterior edge of the foramen occipitalis and a piece of the arch of the atlas 1 cm. broad were then cut away. At this point in the procedure no difference in the tension of the dura or in the consistency of either of the cerebellar hemispheres could be noted. The skin and the muscle flaps were then replaced, and the skin was sutured.

The patient lived only one hour after the operation.

Diagnosis.—The pathologic and anatomic diagnosis was: caries tuberculosa ossis petrosi sinistri; tuberculoma cerebelli ad meatum acusticum internum sinistrum; leptomeningitis basilaris tuberculosa; status post trepanationem cranii in regione squamae occipitalis I die ante mortem factum; caries tuberculosa columnae vertebralis corporis dorsalis VIII subsequente abscessu frigido praevertebrali et paravertebrali; apicitis cavitaria vetustior lateris dextri.

Autopsy Report.—The following is an abstract of the anatomic report. There was an irregular-shaped mass of tissue about the length of a finger joint pro-

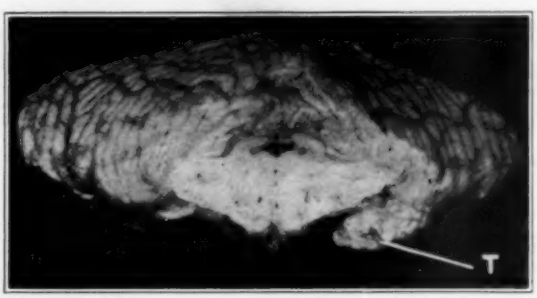

Fig. 1.—Section through the cerebellum showing (*T*) the tuberculoma.

truding above the left meatus acusticus internus. It was torn loose from the side of the skull but was attached to the leptomeninges of the region of the cerebellopontile angle on the opposite side. This tissue was of pulpy consistency and varied from grayish red to yellowish white. Microscopic examination disclosed tuberculous granulation tissue, with typical epithelioid and occasional giant cell tubercles. A sagittal section through the base of the skull in the region of greatest involvement disclosed an irregular cavity pushing through into bone and passing forward toward the outside. This cavity was filled with a creamy golden white fluid.

Macroscopic examination of the left temporal bone and the base of the skull revealed a groove the size of a plum in the bone in the region of the foramen jugulare and the meatus acusticus internus, passing between them and containing necrotic cheeselike material. On further examination this mass was found to extend into both the foramen jugulare and the meatus internus, where it surrounded the nerve. The bulbus venae jugularis on the left side was constricted in an unusual manner, but the wall as well as that of the sinus sigmoideus was normal.

The cross-section demonstrated that the necrotic area had broken through the suture between the os petrosum and the os occipitale and had extended deep into the muscles of the neck. It then reached along the anterior surface of the cervical

vertebrae, to the vicinity of the midline. Following through its lateral extension, the necrotic area was found to extend below the semicircular canals, passing almost to the mastoid process. No point on the posterior surface of the pyramid was involved, and the region of the saccus endolymphaticus was completely normal.

On this side (left) the area spread by lateral extension to the internal carotid artery in its descending portion. On inspection of the semicircular canals I found

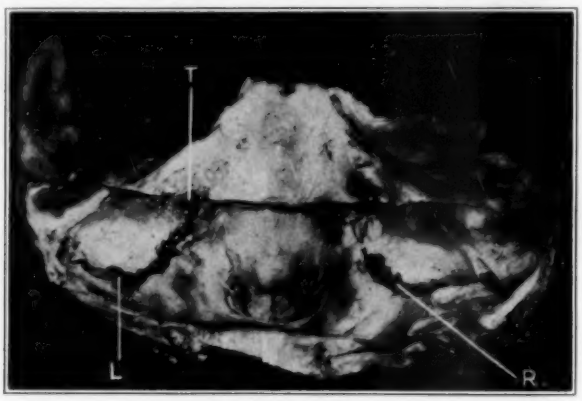

Fig. 2.—The base of the skull as seen from above. *T* indicates the tuberculous area; *L*, the left sigmoid sinus, and *R*, the right sigmoid sinus.

Fig. 3.—Section through the base of the skull and both labyrinths. *A* indicates the antrum; *S*, the semicircular canal; *T*, the tuberculous area; *V*, the vestibule; *D*, the drum; *E*, the external canal; *F*, the facial nerve, and *M*, the middle ear.

them to be filled by caseous material. The antrum was filled with delicate adhesions. Reaching forward, it extended deep below the clivus blumenbachii to the proximity of the posterior wall of the sphenoid sinus. This cavity was involved and was filled with the same necrotic material I had seen in the other regions.

The sinus cavernosus as well as the anterior surface of the pyramid was entirely normal.

On the right side the oval window and the cisterna perilymphatica were filled with necrotic tissue of caseous type. The same was true of the internal auditory meatus. The middle ear, however, remained practically normal. The drum membrane on this side showed no changes.

On the left side the entire inner ear, areas of the bony facial canal and small portions of the middle ear had undergone caseation necrosis.

COMMENT

The complete picture in this case was that of tuberculous osteomyelitis of the vertebral column, with cold abscesses, a tubercle of the cerebellum and tuberculosis of the base of the skull. Of these various tuberculous infections, that of the base of the skull was of most importance and likewise of greatest interest. I believe the case to be of further importance because in this instance a tuberculous process attacked the base of the skull of an adult. There are several cases on record of tuberculosis of the cranial vault and of the mastoid process, but in practically all instances the conditions were found in children. In the literature, in the cases described by Bergmann, Küttner and Israel tuberculosis of the petrous bone existed collateral to multiple tuberculous areas in the cranial vault. A different picture of the frequency of tuberculosis of the temporal bone was produced by the investigation of Grünberg. He studied fourteen children, varying in age from 4 months to 4 years, with generalized tuberculosis. In twelve he found evidence of tuberculous osteomyelitis of the temporal bone of hematogenous origin.

Grünberg's investigation is of great importance because it adds evidence to the belief that when otitis in sucklings fails to heal in spite of appropriate treatment, tuberculosis is often the cause. Also, the investigation is of importance because it shows that when a tuberculous process is localized in the medullary spaces of the pyramidal apex it has a marked tendency toward spontaneous healing. His results concur with my belief that tuberculosis of the petrous tip is often missed because of its abortive nature.

The findings in the case herewith reported were in many ways different from those of Grünberg: First, an adult was concerned. Second, both sides of the vault of the cranium were macroscopically intact, but a focus of tuberculosis in the region of the left mastoid process had extended into the surrounding bone, spreading through the inner auditory meatus and involving the inner ear. Since a focus of tuberculous meningitis has been pointed out in the region of the left mastoid process, it seems reasonable to believe that the right inner ear was infected by extension from this source.

In retrospect, I find the clinical symptoms to be in accord with the pathologico-anatomic findings. First, the intact drum membranes may

be explained on the basis of an infection which spread from the inner ear outward rather than from outside in. Second, the gradual changes in the cochlear and vestibular apparatus, as evidenced by the absence of spontaneous nystagmus and vertigo of greater intensity along with negative symptoms of fistula, are readily explained. Third, the partial retention of the hearing function on the right side does not speak against the existence of tuberculosis of the cochlea, since the presence of a tuberculous serous exudate in the cochlea does not necessarily interrupt the function of hearing.

In spite of this accord I must admit that it was impossible for me to make a diagnosis, since I believed that the choked disk and other neurologic symptoms rather pointed to a tumor of the cerebellopontile angle. The roentgen diagnosis of the carious area as an anatomic variation shows how difficult the diagnosis of pathologic processes in the base of the skull may be. However, had the findings concerning the ear been correctly interpreted, the correct diagnosis might have been reached earlier, as the caloric inexcitability of the two sides along with the diminution of hearing on both sides, the left more than the right, should have led one to believe that there must be a tumor of each of the cerebellopontile angles or a tumor of the cerebellopontile angle on the right side combined with a meningeal process of the left side in order to explain the symptoms. Other evidence also added support to these findings. Even though the final outcome of the case could not have been changed, regardless of the interpretation, it is of interest to point out in conclusion that in the turning test in this case a small amount of irritability of both sides was present, while the caloric test produced no excitation of either side.

PSEUDOCEREBELLAR ABSCESS

S. L. SHAPIRO, M.D.
CHICAGO

It is a truism in otolaryngology that the early diagnosis of an abscess of the brain following infection of the ear is essential toward insuring the best chance of recovery. The prompt recognition of conditions which may simulate this dangerous complication is, for obvious reasons, equally important. When it is borne in mind that the treatment of abscess of the brain, at least after the acute stage, nearly always involves incision or at least aspiration of the collection of pus, it becomes all the more evident that the physician should be on the watch for possible errors in diagnosis, so as to avoid unnecessary traumatization and possible infection of a sterile brain. The following case report illustrates a condition which from this standpoint is peculiarly likely to serve as a pitfall for the otologist.

REPORT OF A CASE

The patient whose history forms the subject of this paper was a man, aged 22, who was first seen in the outpatient department of the Research and Educational Hospital on June 6, 1933, with the complaint of a discharging right ear of nine years' duration. Examination at that time revealed on this side an attic perforation in the drum with some foul-smelling discharge in the canal; the other ear showed a healed central perforation and a dry canal. He was given routine treatment for the suppurating right ear and improved considerably in the next two months.

I saw the patient for the first time on Sept. 12, 1933, when he came in because of spells of dizziness, which he had noticed for the past two or three weeks. My examination of the right ear showed a small perforation of the attic with granulations around it together with a moderate amount of foul discharge from the external canal. The patient stated that his ability for hearing conversation was largely confined to the suppurating ear, and this was corroborated by tests in which the whispered voice could be heard 7 feet (2.1 meters) on the right side as against 3 feet (91 cm.) on the left. Tests with the tuning fork indicated bilateral conduction deafness, which was more marked on the left side. There was a questionable 1 degree spontaneous nystagmus to the left; the test for fistula in the suppurating right ear gave positive results. The caloric test indicated a live labyrinth on both sides.

Diagnosis.—Chronic suppurative otitis media with circumscribed labyrinthitis was present on the right side.

From the Ear, Nose and Throat Department, University of Illinois College of Medicine.

This case was presented at the meeting of the Chicago Laryngological and Otological Society, Nov. 5, 1934.

Treatment and Course.—Because of the fact that the right ear was the one the patient chiefly depended on for hearing, further conservative treatment was decided on, and the attic was irrigated with a 50 per cent solution of alcohol. He was told to return the following week.

Fifteen days later the patient was admitted to the hospital with a complaint of marked dizziness, nausea, vomiting, pain in the right ear and chills of four days' duration. The otologic functional examination at that time revealed complete deafness on the right side, a 2 degree horizontal rotatory nystagmus to the left, which did not change direction on change of position of the head, and spontaneous past pointing and drift reaction to the right. The general physical and neurologic examination gave negative results. The white blood count was 12,700, with 90 per cent polymorphonuclears. The lumbar puncture showed a clear fluid under approximately normal pressure, with a cell count of 4 to the cubic millimeter; the Tobey-Ayer test for sinus thrombosis gave negative results. The diagnosis was acute exacerbation of chronic suppurative otitis media with diffuse manifest suppurative labyrinthitis.

The patient was put to bed and kept at absolute rest. Twenty minutes after admission he had a chill, and the temperature went up to 104 F., but his fever soon subsided, and for the following week he was afebrile. Three blood cultures taken during this time were negative. After the first week he continued to improve from the standpoint of subjective symptoms but began to have a low grade fever in the afternoon, unaccompanied by any other signs. This fever gradually increased, the temperature going as high as 103 F. Three weeks after his admission to the hospital it was decided to operate. At that time the following notation was made: "This patient has had evidence of moderate sepsis for several days, with increasing fever for the past three days. The symptoms in the labyrinth are quieting down, although there is still some spontaneous nystagmus to the left.

"The preoperative diagnosis was subacute diffuse manifest labyrinthitis with complicating extradural abscess, possibly in contact with the sinus."

At operation the mastoid cavity was found to be almost obliterated by a sclerosing process. When the antrum was opened a large cholesteatoma was found: this had broken through the aditus and extended into the epitympanum. On removal of the cholesteatoma a good-sized erosion was seen on the horizontal semicircular canal. An extensive radical operation on the mastoid was performed, followed by a Neumann operation on the labyrinth after the technic described by Schlander. The posterior semicircular canal and the smooth end of the horizontal semicircular canal were opened, and the vestibule was entered from behind; the promontory was opened with a curet, and the stapes was removed together with the other ossicles. Granulations were seen in the oval window after removal of the stapes; there was no flow of cerebrospinal fluid. On the completion of the operation on the labyrinth, the bone overlying the sigmoid sinus and anterior to it was removed, about a teaspoonful of pus being evacuated. The cerebellar dura and the sinus were found to be covered with granulations. Because of the length of time the boy had been under the anesthetic it was decided not to explore the sinus, and he was returned to bed.

On the following day the condition was good. A slight blurring of the disks was noted by the ophthalmologist. On the fourth day after the operation, because of the continued fever, the jugular vein was ligated and the sinus was opened. An organized thrombus, obviously several days old, was found, and bleeding was obtained from the central but not from the peripheral end. Three days after the second operation a frontal headache developed, which persisted for several days,

and vomiting occurred once. There were no meningeal changes. Two days later the disks were definitely swollen. The choking of the disks increased to about 3 diopters within two weeks. Lumbar puncture showed a clear fluid under considerably increased pressure, with a count of from 4 to 8 cells per cubic millimeter. Dr. Oldberg, of the department of neurosurgery, was consulted. He said: "I suggest exploring the old operative area for the possibility of further formation of extradural abscess. If it is not found, cerebellar puncture at a future time may be indicated." On November 22 the vestibular findings and choked disks were still present, and in addition the boy showed inability to touch the nose with the right hand on the finger to nose test and also weakness with the right hand in the test for adiadokokinesis. At that time a cerebellar abscess was strongly suspected, but I was deterred from exploring the brain by the fact that the subjective symptoms were improved, that the boy was bright mentally and that the Schilling test showed no shift to the left. On November 28 the swelling of the disks had increased somewhat, but the cerebellar signs had disappeared and the general condition was still good. One week later the disks were noted to be improved. From that time on the patient made a rapid recovery; he left the hospital on December 13 in good condition. The choked disks went down completely within the next few weeks, leaving, however, some constriction of the field for form. I have seen him at intervals during the past two years, and he has a dry ear, with no complaints or symptoms beyond the total deafness on the right side.

COMMENT

Summarizing this boy's history, it may be stated that a patient is presented, who in the course of a chronic otitis media suppurativa and circumscribed labyrinthitis acquired a diffuse manifest suppurative labyrinthitis, extradural abscess of the posterior fossa and sinus thrombosis. Coincident with or after operation for these complications, he showed choked disks, considerably increased pressure of the cerebrospinal fluid, frontal headache, vomiting and some evidence of incoordination suggestive of cerebellar involvement on the right side. All these symptoms disappeared in the course of four weeks, and the patient has remained perfectly well for over two years. Before discussing the possible factors which served to produce the symptom complex just mentioned, it may be well to glance briefly at some of the similar cases reported in the literature.

Increased intracranial pressure without actual involvement of the brain accompanying suppurative conditions in the ear has been described several times. The symptoms may vary from mild choking of the disks without any other findings to severe pictures in which the patient presents all the evidence of a rapidly advancing cerebellar abscess or tumor of the posterior fossa. The first type of case was discussed by Harold I. Lillie and Walter I. Lillie[1] of the Mayo Clinic, who

1. Lillie, Harold I., and Lillie, Walter I.: Choked Disks in Association with Surgical Mastoid Disease Without Apparent Intradural Involvement, Tr. Am. Otol. Soc. **17**:268, 1925.

summarized the literature and reported four cases of their own in which the choking of the disks ranged from 1 to 4 diopters. With the exception of diplopia in one instance there were no signs of intracranial involvement other than the choked disks, and in all four cases this condition disappeared some weeks after mastoidectomy.

Sinus thrombosis has long been known to produce choking of the disks in a considerable percentage of cases. The subject was recently discussed by Ersner and Myers,[2] who made the interesting suggestion that the cause was probably an inequality in the size of the lateral sinuses, obstruction of the larger sinus tending to produce papilledema when such inequality is present. Through the assistance of Dr. Kavanaugh of this city I obtained a description of the technic used by these authors and made a roentgenologic study of the jugular foramina of my patient; these were found to be equal in size, eliminating this factor as a cause of the intracranial symptoms.

The more severe cases were first thoroughly studied by Bárány [3] in 1913, although Bing had previously described one such instance. Most of the patients had suppuration from the middle ear. The syndrome which came to be called after Bárány consisted of headache, vertigo, deafness and in some instances nystagmus of a central type and cerebellar manifestations. Increased intracranial pressure was demonstrated in all instances by lumbar puncture, but choked disks were present only in some cases. The patients were cured either by lumbar puncture or by incising the cerebellar dura. Similar cases have been recently reported by Jenkins [4] in 1926 and by Fraser and Tweedie [5] a year later.

There is a marked tendency for this symptom complex to simulate cerebellar abscess, as indicated by the fact that all the authors mentioned, even the Lillies in their group of cases of mild involvement, had explored or operated with the intention of exploring the cerebellum in one or more of the cases. I cannot resist citing a case recently reported by Moulonguet and Anglade [6] which aptly illustrates this tendency. Their patient was a man suffering from an old suppuration

2. Ersner, M. S., and Myers, David: An Aid to Interpretation of Intracranial Complications Resulting from Venous Circulatory Disturbance of the Temporal Bone, Laryngoscope **43**:800, 1933.

3. Bárány, R.: Syndrome of Barany, Tr. Internat. Cong. Med. **14**:571, 1913.

4. Jenkins, G. J.: Cystic Serous Meningitis, J. Laryng. & Otol. **41**:781, 1926.

5. Fraser, J. S., and Tweedie, A. R., in discussion on Portmann, G.: J. Laryng. & Otol. **42**:809, 1927.

6. Moulonguet, A., and Anglade, L.: Syndrome hypertensif de la fosse cérébrale postérieure pris pour un abcès cérébelleux, Rev. d'oto-neuro-opht. **12**:513, 1934.

of the ear, who consulted them because of vertigo which was apparently not of peripheral labyrinthine origin. After a mastoidectomy the symptoms continued. Headache made its appearance, and later slow pulse, vomiting and drowsiness. The patient was observed for six months after the operation, during which time he also showed marked cerebellar signs, the headache became excruciating and he lost considerable weight. A diagnosis of cerebellar abscess was made. At operation it was noted on incising the cerebellar dura that the cerebrospinal fluid spurted to a height of several centimeters. Because of this fact the operation was discontinued; the patient made an uneventful recovery.

The condition in my own case apparently belongs midway between the mild types of intracranial hypertension reported by the Lillies and the severe variety, such as that in the case just cited. I have chosen the name pseudocerebellar abscess as being the one most clearly descriptive in view of the previous history and the symptoms. It is frankly admitted that the possibility of a latent cerebellar abscess manifesting itself at some future date cannot be entirely excluded in such a case, but the lapse of two years without further symptoms would at least indicate that such an event is not probable. In this connection I am enabled through the courtesy of Dr. L. Benno Bernheimer, of the Chicago Laryngological and Otological Society, to cite the following unusual case from his practice:

M. Q., a girl aged 6 years, had acute otitis media on the right side on Oct. 25, 1928; after paracentesis there was a stormy course, symptoms of involvement of the mastoid appearing on Nov. 15, 1928. On November 19 a simple mastoidectomy was performed. Recovery was uneventful until the eighth postoperative day, when cerebellar symptoms developed—headache, spontaneous rotatory nystagmus, low grade fever and mild ataxic symptoms. A tentative diagnosis of cerebellar abscess was made, but it was decided to follow a conservative plan of treatment rather than to explore the brain. Daily spinal punctures were performed for eight days, the fluid being normal but under somewhat increased pressure. On the ninth day all symptoms had subsided, and one week later the child left the hospital. She was under my observation for the following twenty-one months and was apparently in perfect health. At that time she acquired scarlet fever and died from complications following this disease. At autopsy a well healed cerebellar abscess was found on the right side.

A few words should be said about the pathologic condition underlying manifestations of increased intracranial pressure without actual intradural involvement. The condition has been variously termed serous meningitis, spinal arachnoiditis of the posterior fossa, cystic arachnoiditis and precerebellar cyst. All these names have a common substratum in that they assume the symptoms to be the result of an unusual accumulation of fluid in the cerebellopontile cistern, which may either communicate with the other subarachnoid spaces or be shut off by adhesions to form a cystlike collection of fluid between the dura of the posterior

fossa and the cerebellum adjacent to the petrous bone.[7] In the first instance it may be absorbed or cured by a lumbar puncture; in the second the fluid must be evacuated through an incision in the dura.

There are at present no cases in which postmortem records or histologic studies of material removed at autopsy are available. There are, however, a considerable number of case reports involving cystic arachnoiditis mistaken for acoustic or cerebellar tumor which serve to shed some light on the subject. This condition, which produces symptoms similar to those I have mentioned in my case but of a more chronic and severe character, has been shown by Horrax [8] to be accompanied by thickening of the arachnoid, or middle layer of the meninges, which is evident both grossly and microscopically. Horrax expressed the belief that a previous otitis media is frequently the etiologic factor in producing this low grade inflammation of the arachnoid membrane. It is probable that a similar process is responsible for the symptoms in those cases of suppuration of the ear in which there are signs of increased intracranial pressure without actual involvement of the brain.

---

7. Ramadier, J.: Meningites hypertensives des otologistes et meningites séreuses et arachnoidites des neurologistes, Rev. d'oto-neuro-opht. **12**:491, 1934.

8. Horrax, Gilbert: Generalized Cisternal Arachnoiditis Simulating Cerebellar Tumor: Its Surgical Treatment and End-Results, Arch. Surg. **9**:95 (July) 1924.

OBSERVATIONS ON THE LARYNX IN THE TUBERCULOUS

FRANKLIN P. SCHUSTER, M.D.
EL PASO, TEXAS

The basis of this paper is the clinical study of the larynx in 452 cases in which pulmonary tuberculosis was associated with subjective complaints referable to the ear, nose or throat. Approximately 95 per cent of the patients were considered ambulatory, and as a group they were receiving home or sanatorium treatment. In the majority the pulmonary condition was chronic or subacute.

The clinical invasion of the larynx by the tubercle bacillus is one of the most frequent complications of pulmonary tuberculosis that laryngologists are called on to treat. In this study particular attention is given to this complication.

FREQUENCY OF TUBERCULOUS LARYNGITIS

There is a wide variation in the statistics concerning the frequency of tuberculous laryngitis. Ornstein [1] reported that the frequency of tuberculous laryngitis is as low as 4.4 per cent, Looper and Schneider [2] 15.5 per cent, Lockhard [3] an average of 34.5 per cent in a series gathered from a large number of statistical reports, and Fetterolf [4] 83 per cent, in a series of 100 autopsies. In my group of patients, 87, or 19.2 per cent, had clinical tuberculous laryngitis.

These statistics are cited merely to show the wide discrepancy and to emphasize the fact that to get an accurate picture one must analyze the stage of the pulmonary involvement and also the social condition of the patient. The literature reveals, in addition, that tuberculous laryngitis is found in much greater frequency in pathologic

---

Presented as a candidate's thesis for the American Laryngological, Rhinological and Otological Society, Inc.

1. Ornstein, G. G., in discussion on Dworetzky, J. P.: Lung Immobilization in the Treatment of Pulmonary Tuberculosis and Its Influence on the Larynx (A Further Report), Tr. Am. Laryng., Rhin. & Otol. Soc. **36**:12, 1930.

2. Looper, E. A., and Schneider, L. V.: Laryngeal Tuberculosis: A Study of Five Hundred Patients Treated at the Maryland State Sanatorium from 1923 to 1928, J. A. M. A. **91**:1012 (Oct. 6) 1928.

3. Lockhard, L. B.: Tuberculosis of the Nose and Throat, St. Louis, C. V. Mosby Company, 1913, p. 58.

4. Fetterolf, G. E.: The Larynx in One Hundred Cases Dying of Pulmonary Tuberculosis, Tr. Am. Laryng. A. **36**:258, 1914.

examinations than in clinical studies. Spencer and Summerill [5] have demonstrated tuberculous laryngitis in histopathologic studies antedating all clinical evidence of the disease.

ETIOLOGY

In this group of 452 cases, of all predisposing causes, only age, sex and pregnancy had any bearing on the development of tuberculous laryngitis.

Age.—Tuberculosis is primarily a disease of the young. The largest percentage of the patients of this series were under 30, accounting for 41.5 per cent of the group; 74.9 per cent were below 40. However, it is not uncommon to find active pulmonary tuberculosis of the chronic or fibroid type in the aged. In this study, 6.4 per cent of the patients were above 50, the oldest being 66.

Of the 87 patients with tuberculous laryngitis, 31 per cent were under 30 and 69 per cent were above 30. The youngest was 19, the oldest 59. From the comparison of these figures, it is evident that the largest percentage of the patients with pulmonary tuberculosis were under 30, while the largest group of patients with tuberculous laryngitis were above 30.

Lockhard [3] stated that there is an apparent immunity to tuberculous laryngitis in children. My own and other statistics indicate that there is apparently a relative immunity in the young. Dworetzky [6] did not find any instance of the disease among 100 children. Looper [2] reported only 1 case, in a child 10 years of age. On the other hand, Spencer [7] stated that tuberculous laryngitis is rather frequent in persons past 45. Wilkinson [8] reported its occurrence in 5 patients above 50, one of whom was 74, in a group of 45 cases. I believe that invasion of the larynx tends to come late in the course of the disease, irrespective of age, rather than that there is any specific or relative immunity in the young.

Sex.—Of the group of patients as a whole, 58.5 per cent were men and 41.5 per cent were women. Of the patients with tuberculous laryngitis, 70 per cent were men and 30 per cent women, the condition being 2.33 times as frequent in males. This would distinctly point to men's being more susceptible than women and corresponds to the

5. Spencer, F. R., and Summerill, F.: Histopathology of the Larynx Antedating Clinical Evidence of Laryngeal Tuberculosis, Tr. Am. Laryng. A. **54**:178, 1932.

6. Dworetzky, J. P.: Etiology and Prophylaxis of Tuberculous Laryngitis, Ann. Otol., Rhin. & Laryng. **23**:835, 1914.

7. Spencer, Frank R.: Laryngeal Tuberculosis, Philadelphia, J. B. Lippincott Company, 1927.

8. Wilkinson, R. W.: Laryngeal Tuberculosis: Some Experiences and Observations, Arch. Otolaryng. **16**:331 (Sept.) 1932.

statistics of Spencer,[7] Wilkinson,[8] Lockhard [3] and others, although St. Clair Thomson [9] reported the patients to be approximately evenly divided between the two sexes. This preponderance of men has been attributed to their more general use of tobacco and alcohol. For all the men, however, the history of the use of tobacco and alcohol was as frequent among those with only pulmonary involvement as among those with laryngitis.

Pregnancy.—In 4 cases tuberculous laryngitis was precipitated by pregnancy. This is simply a result of the recognized deleterious effect of pregnancy in activating the general disease throughout the host, as emphasized by Freudenthal.[10]

Other Causes.—Other predisposing causes, such as cold and warm climates, toxic agents and outdoor or indoor occupation, were about equally divided between the patients with tuberculous laryngitis and those with nontuberculous laryngitis.

In this series, infections of the nose and throat were no more frequent in patients with tuberculosis of the larynx than in those in whom the disease was limited to the lung. These conditions are emphasized by many authors as important predisposing causes.

Local trauma is a factor which was not noted but which must be considered. Greene [11] mentioned 4 patients, 3 of whom acquired tuberculosis of the epiglottis after direct examination of the larynx, stressing the possibility that trauma by the speculum played a part in the spreading of the infection.

There are other predisposing factors, difficult to reduce to a statistical basis, in the incidence of tuberculous laryngitis, such as the general resistance of the patient to tuberculous infection. This resistance may be hereditary, racial or acquired in early childhood and can occasionally be estimated by the blood sedimentation time, a shift to the left in the Schilling blood count and pulmonary response to treatment. There is, in addition, the local immunity spoken of by Fenton.[12]

The exciting cause of tuberculous laryngitis is the invasion of the larynx by the tubercle bacillus. The modern conception is that it is always secondary to tuberculosis elsewhere, and this is supported by clinical and pathologic evidence of most authorities. When one con-

9. Thomson, St. Clair: Tuberculosis of the Larynx: Ten Years' Experience in a Sanatorium, London, His Majesty's Stationery Office, 1924, p. 9.

10. Freudenthal, W.: The Baneful Influence of Pregnancy on Laryngeal Tuberculosis, Laryngoscope **17**:930, 1907.

11. Greene, J. B.: Some Aspects of Laryngeal Tuberculosis, Tr Am. Laryng., Rhin. & Otol. Soc. **36**:484, 1930.

12. Fenton, R. A.: Immunity in Otolaryngology, Tr. Am. Laryng., Rhin. & Otol. Soc. **37**:426, 1931.

siders that most persons come in contact with the tubercle bacillus in infancy or early childhood, the possibility of primary invasion of the larynx is at least remote. Spencer [5] stated that he had never seen a case of primary involvement. Lockhard,[3] Arrowsmith [13] and others also questioned its existence, while Wood [14] expressed the belief that it does occur but is extremely rare. Terry,[15] Newhart [16] and others have found tuberculosis in from 5 to 42 per cent of tonsils showing no clinical signs of the disease. Tuberculosis is found post mortem in a large percentage of tracheobronchial glands. Therefore, the primary focus may at times be latent and extremely difficult to demonstrate clinically. In all my cases the condition was secondary to clinical pulmonary tuberculosis.

ROUTE AND MODE OF INFECTION

Most observers believe that infection of the larynx comes through contact with bacteria-laden sputum passing over and frequently resting for a long period in the larynx. Other prominent workers in this field feel that infection is usually through the lymphatics, citing the fact that pathologically the tubercles are subepithelial and none occur in the epithelium. Supporting the former theory, however, is the fact that tubercle bacilli can penetrate normal mucous membrane without leaving any surface lesion and that tuberculous lesions are most frequently formed in the posterior portion of the larynx, where from an anatomic standpoint the sputum is prone to lodge.

Personally, I feel that infection via the sputum is the best supported clinically and the most frequent. In my series of patients the sputum contained the organisms approximately as often in instances of nontuberculous laryngitis as in those of tuberculous laryngitis. In 82 per cent of the cases the sputum contained the organisms at some time in the course of the disease. Of Wilkinson's [8] series of 45 patients with far advanced and neglected tuberculous laryngitis, the sputum was normal in 22 per cent. Dobromylski [17] found that 9 per cent of his patients with tuberculous laryngitis had no tubercle bacilli in the sputum,

---

13. Arrowsmith, H.: Present-Day Aspects of Laryngeal Tuberculosis, Tr. Am. Laryng. A., 1917, p. 282.

14. Wood, G. B.: The Etiology of Tuberculosis in the Upper Respiratory Tract, Tr. Am. Laryng., Rhin. & Otol. Soc., 1902, p. 264.

15. Terry, G. H. B.: Eye, Ear, Nose and Throat Complications Occurring in Patients in a Hospital for the Tuberculous, Arch. Otolaryng. **11**:403 (April) 1930.

16. Newhart, Horace; Cohen, S. S., and VanWinkle, C. C.: Tonsillectomy in the Tuberculous: Incidence and Pathology of Tuberculosis of the Tonsils in Adults, Ann. Otol., Rhin. & Laryng. **43**:769 (Sept.) 1934.

17. Dobromylski, F. I.: Chronische Kehlkopftuberkulose bei abacillären Kranken, Ztschr. f. Hals-, Nasen- u. Ohrenh. **33**:140, 1933.

suggesting that in these patients the condition was hematogenic. Greene [11] stated that the mode of infection is of scientific interest only and has no bearing on the course or prognosis of the disease.

The low incidence of tuberculous laryngitis, associated with active pulmonary tuberculosis in which the sputum contains bacilli is noteworthy. It suggests a high degree of specific resistance of the tissue to clinical invasion by the tubercle bacillus in the upper respiratory tract. Clinical tuberculosis of the nose, sinuses, tonsils and pharynx, tongue and buccal cavity is comparatively rare, except as terminal spreading lesions. Terry [15] observed only 1 instance of tuberculosis of the nose, none of the sinuses and 10 of the tongue in a large series over three years. Havens [18] was able to report 5 cases of tuberculosis of the nose, and he collected reports of 15 from the American literature. In my series there was no instance of involvement of the nose or sinuses, 1 of the tongue, 3 of the tonsil and 1 of the pharynx, all associated with tuberculous laryngitis. There were, however, 25 cases of tuberculous otitis media, 2 of tuberculous mastoiditis associated with nontuberculous laryngitis and 4 of tuberculous glands of the neck, 1 of which was associated with tuberculous laryngitis.

On the other hand, tuberculous patients possess no immunity to other infections of the upper respiratory tract; in fact, from the general lowered resistance they seem more susceptible to such conditions as common colds, sinusitis and laryngitis. In the group of cases in which tuberculosis was limited to the lungs, there were 65 cases of acute or chronic laryngitis, 68 of sinusitis, 15 of pharyngitis, 59 of acute or chronic otitis media, 67 of infected tonsils, 21 of allergy, 22 of deflected septum and 36 of atrophic rhinitis. I want to emphasize that these conditions were of importance symptomatically and that consultation for their relief was requested by the specialist in disease of the lungs. In 19 patients, tonsillectomy was performed with the area under local anesthesia. The indications were definite and clear, and operation was advised only after a period of observation, during which the general condition of the patient failed to respond to conservative treatment. One patient was given artificial pneumothorax forty-eight hours before operation as a preliminary preparation. The indication was from the pulmonary standpoint. Section of four of the tonsils from these patients failed to reveal any tuberculous infection. All healed promptly and improved generally, and none acquired tuberculous lesions of the upper respiratory tract, over two years.

The relative infrequency of tuberculosis in the upper respiratory tract is remarkable when one considers that the tubercle bacillus gains

18. Havens, Fred Z.: Primary Tuberculosis of the Nasal Mucous Membrane, Arch. Otolaryng. **14**:181 (Aug.) 1931.

entrance to the host either by inhalation or by ingestion and must pass over or through these upper respiratory structures, certainly more subject to exposure and trauma than the lungs or the tracheobronchial glands, where the tuberculosis is found with much greater frequency.

There is one factor that I feel plays an important part in the development of tuberculous laryngitis. Pottinger [19] has called attention to the parasympathetic reflex, in which the afferent impulses course in the pulmonary branches of the vagus and the efferent fibers course in the laryngeal branch. Irritation of these afferent fibers by inflamed pulmonary tissue produces trophic changes and atrophy in the larynx. Atrophy was noted in 9 per cent of the patients with tuberculous laryngitis. Pottinger expressed the belief that this disturbance lowers local tissue resistance in the larynx and offers a reasonable explanation for the fact that tuberculous laryngitis is practically always secondary to pulmonary tuberculosis and that if the lesions are unilateral they usually occur on the side of the pulmonary disease.

PATHOLOGIC PICTURE

The pathologic picture of tuberculous laryngitis is essentially that of tuberculosis elsewhere, modified by the anatomic structure and location in the larynx. Microscopically, the lesion is a chronic granuloma, an inflammatory or allergic response to the tubercle bacillus toxin. There are round cell infiltrations and epithelioid cells about the bacilli and occasional giant cells of Langhans. There is frequently coagulation or caseous necrosis at the center of the tubercle, which is avascular and is located in the subepithelial layer but may necrose to the surface and involve the epithelium, resulting in ulceration either by pressure or by round cell infiltration.

Macroscopically, in the larynx the pathologic picture is extremely protean, more than one type of lesion usually occurring in the same larynx. Of my patients, only 3 had solitary lesions. The condition may simulate almost any of the numerous diseases of the larynx and is, in fact, frequently complicated by secondary or coexisting nontuberculous disease. Grossly, congestion, anemia or extreme pallor, atrophy, infiltration, edema, tubercles, tuberculoma, ulceration, perichondritis and chondritis are present. The types of lesion noted in this series in the order of their frequency were as follows: infiltration or edema, 96.6 per cent; asymmetric hyperemia, 65.6 per cent; extreme pallor or anemia, 20.4 per cent; ulceration, 20 per cent; tubercles, 9.1 per cent, and atrophy, 9 per cent. Various stages of paresis and paralysis of the cords

19. Pottinger, F. M.: Symptoms of Visceral Disease, St. Louis, C. V. Mosby Company, 1930, p. 366.

are generally manifestations of pressure and traction on the recurrent laryngeal nerve and therefore are not considered as true laryngeal disease.

LOCALIZATION OF LESIONS

In 76 per cent of the cases the lesions were bilateral; in 24 per cent, unilateral. Asymmetry of lesions, with the possible exception of cases in which disease was limited to the epiglottis, occurred in all the cases. The order of frequency of involvement of various sites was: interarytenoid space, 46 per cent; cords, 43 per cent; epiglottis, 36 per cent; arytenoid cartilages, 30 per cent; ventricles, 24 per cent; subglottic area, 5 per cent.

Symptoms.—The symptoms of tuberculous laryngitis depend on the type of lesion present (laryngeal stage) and on its localization. The principal subjective symptom of intrinsic localization is vocal change. This may vary from a slight huskiness to vocal fatigue and from dysphonia to complete aphonia. Paresthesias, tickling, sensation of a foreign body and dryness are frequent complaints, occasionally reflex coughing. My experience is that the diagnostic value of these symptoms is questionable, as they are found frequently in cases of nontuberculous laryngitis. It is noteworthy that pain, and in fact all subjective symptoms, may be entirely lacking, as Solenberger [20] pointed out, even in disintegrating types with extrinsic involvement. However, when the disease is extrinsic, pain is usually one of the most distressing complaints. This is not constant but is described as sharp and knifelike, excruciating on swallowing or talking, and frequently referred to the ear. Dyspnea occasionally may occur owing to narrowing of the glottis by infiltration, edema and tuberculoma. However, this symptom is also due to narrowing from paralysis of the cords and at times to "air hunger" from extensive pulmonary disease or bronchial stenosis.

Because of the extremely protean character of tuberculous laryngitis, the objective findings are varied and there is really no typical early picture. General congestion of the larynx was noted earlier and more frequently than extreme pallor, but while these findings are sometimes spoken of as pathognomonic, unless they occur asymmetrically or in conjunction with infiltration, one of the earliest pathologic processes, they cannot be considered indicative of clinical tuberculous laryngitis.

There are, however, characteristic findings in various portions of the larynx. In this series, the posterior wall was the most frequently involved. The earliest sign noted was an irregular thickening of the mucous membrane or wrinkling, best seen on phonation. As the process

20. Solenberger, A. R.: Prophylaxis of Laryngeal Tuberculosis, Tr. Am. Laryng., Rhin. & Otol. Soc. **18**:480, 1912.

advances, this thickening takes on the appearance of irregular digitations, and as these enlarge and coalese, a thick pad or mass forms, sticking out between the cords. As the tubercles enlarge and come to the surface or break down, ulceration occurs. The ulcers are at first superficial and irregular, the base being covered with yellowish exudate or sputum. Later, as necrosis proceeds, they spread, involving the deeper structures, and the edges and base may contain granulations.

Next in frequency was involvement of the vocal cords. The earliest evidence is a rounding, usually in the posterior third, giving the cord a spindle shape, and vessels may be seen coursing the surface. Superficial ulceration may take place, giving the cord a mouse-eaten appearance.

Epiglottis.—In the epiglottis, the first sign was thickening of the free edge. The epiglottis was injected, firm and sometimes rather granular or warty. This swelling may increase with edema involving the entire structure, giving it the typical turban shape. Ulcers usually appear on the free margin and are rather cleancut, exposing the edge of the cartilage. This may spread until the entire epiglottis is destroyed. This ulcerative process is also seen at times in the far advanced stages as a disintegrating type, in which there is widespread destruction, with only slight infiltration and tissue reaction.

Arytenoid Cartilages.—The first sign noted is a small, rounded, pale, edematous swelling assuming a pear shape as it increases. This may reach a tremendous size, obstructing a clear view of the cords and at times causing difficulty in swallowing and closure of the larynx and rarely obstruction to breathing.

Ventricles.—Infiltration of the ventricles produces a rounded mass which overhangs the cords and may simulate prolapse of the ventricle. Subglottic involvement occurred in only 5 per cent of the cases and consisted of infiltration, causing more or less obstruction to breathing.

Diagnosis.—In the vast majority of cases, a diagnosis of tuberculous laryngitis can be made by what one sees in the larynx. This may necessitate repeated observations and direct examination. The confirmatory aid of the specialist in diseases of the lung, laboratory investigation, examination of the sputum, Wassermann tests, roentgenograms and at times, biopsy, completes the diagnosis. Biopsy, however, is seldom necessary or advisable except to rule out the possibility of malignant growth. One must not be too willing to conclude that all of the lesions of the larynx are tuberculous. Greene [21] and others have shown a large number of nontuberculous lesions in the tuberculous.

21. Greene, J. B.: Nontuberculous Lesions of the Larynx in the Tuberculous, Tr. Am. Laryng. A. **51**:141, 1929.

In recent years roentgen study as an aid in the diagnosis of disease of the larynx has received enthusiastic acclaim by Woods [22] and Jackson [23] owing to the work of Thost and Wotzilka in Germany and of Pancoast in this country.

DIFFERENTIAL DIAGNOSIS

Chronic catarrhal laryngitis must be ruled out because it is so frequently found in the larynges of the tuberculous. It was noted in 65, or 14 per cent, of all the persons examined. There is a general redness of the larynx—all of the mucous membrane tends to be equally affected, in contradistinction to the asymmetrical lesions usual in tuberculosis.

Syphilis is prone to attack the anterior portion of the larynx; the injection is more of a brick red, and the ulcers are sharp and punched out. The lesions tend to be more extensive, destroying identity of structures. Wassermann and therapeutic tests help to clarify the picture.

Carcinoma may resemble tuberculous laryngitis. It generally produces a more localized lesion, smaller and usually unilateral. Personally, when doubt exists, I have no hesitancy in doing a biopsy, provided the patient is prepared and physically able to proceed with radical treatment. If the condition proves to be tuberculous, the raw edges are cauterized. One must, however, bear in mind Lynch's [24] warning,"I have made the mistake a number of times of believing the report of one microscopic section." The two conditions may coexist, and Tucker [25] reported a case in which changes typical of both were noted in the same section.

Laryngitis sicca, especially when the cords are injected, hemorrhagic and have crusts, may have to be differentiated. The lesions are tenacious crusts, and the membranes are thin, dry and glazed. As a rule, ulcers are not present, and usually atrophic rhinitis is present. Rarely pachyderma laryngis, scleroma, lupus and leprosy must be ruled out. Hysterical aphonia was not noted in this series, but its occurrence, especially in nervous persons, must not be overlooked.

---

22. Wood, G. B.: Laryngeal Tuberculosis, Arch. Otolaryng. **17**:701 (May) 1933.

23. Jackson, Chevalier L.: The Diagnosis of Laryngeal Disease: Laryngoscopic Appearances Corrected with Roentgenologic Observations, J. A. M. A. **95**:1322 (Nov. 1) 1930.

24. Lynch, R. C.: Observations of a Laryngologist, J. A. M. A. **95**:1795 (Dec. 13) 1930.

25. Tucker, Gabriel: A Case of Chronic Hoarseness Showing Tuberculosis and Cancer in the Same Lesion, J. A. M. A. **96**:1572 (May 9) 1931.

PROGNOSIS

Prognosis depends on so many variable factors that statistics are of little value in making a definite decision. The occurrence of tuberculous laryngitis materially and unfavorably affects the general prognosis as to life, in fact, it frequently determines the ultimate outcome. All the older authors considered the prognosis hopeless and treatment futile.

Early diagnosis and, more recently, advances in the surgical treatment of both pulmonary and laryngeal tuberculosis have improved the prognosis of this serious complication. Each year has seen various authors better the prognosis. Spencer [26] stated that from 70 to 80 per cent are curable if the diagnosis is made early, and Woods [27] stated that as high as 90 per cent can be cured.

In my series 15 lesions, or 17.2 per cent, are considered healed; 47, or 54 per cent, improved or quiescent, and 9, or 19.2 per cent, unimproved. Sixteen, or 18.4 per cent of the patients have died. Of these, 2 died directly from tuberculous meningitis, one from Addison's disease, one from persistent hiccup which could not be controlled even by bilateral phrenicotomy and the others from their pulmonary disease. These patients have been followed over periods varying from a few months to five years. My experience is that the favorable prognosis applies only to the healing of the local tuberculous lesion in the larynx. St. Clair Thomson [28] brought out the significant point that of 2,541 patients discharged from King Edward's Sanatorium, the proportion of those alive between one and ten years later was twice as high among those with sound larynges as among those who had had tuberculous laryngitis.

TREATMENT

In the treatment of tuberculous laryngitis one must remember that one is treating a secondary infection from a primary focus in the lung. Therefore, attention to the lungs should receive primary consideration. However, as this secondary invasion of the larynx frequently determines the final issue, it is important to attack it vigorously, along with the treatment of the primary focus.

Prophylaxis should be practiced by routine and repeated examination of the larynges of all tuberculous patients when their general condition permits, and there should be close cooperation with the specialist in diseases of the lung in the general management of the patient. On

26. Spencer, Frank R.: The Diagnosis, Differential Diagnosis and Prognosis of Laryngeal Tuberculosis, Ann. Otol., Rhin. & Laryng. **33**:163 (March) 1924.

27. Woods, G. B., in Jackson, C., and Coates, G. M.: The Nose, Throat, and Ear and Their Diseases, Philadelphia, W. B. Saunders Company, 1929, p. 872.

28. Thomson, St. Clair: The Mitchel Lecture: Tuberculosis of the Larynx; Its Significance to the Physician, Brit. M. J. **2**:841 (Nov. 8) 1924.

the appearance of early or suspicious symptoms, absolute rest of the voice is advisable. This alone has been sufficient to prevent or cure the condition in the early stages. Whispering may be as harmful as talking, as Carmody [29] has pointed out. Attention should be given to hygiene of the nose and throat, and a simple, generous diet, rich in vitamins A and D, is important. When pain and dysphagia are present, it is essential to give relief and to see that the patient receives sufficient food and fluids to maintain the general condition. Many of these patients actually fear to eat on account of the acute pain on swallowing. It has been noted that patients have individual idiosyncrasies in this regard. One may be able to take liquids freely and have trouble with solid or semisolid food. In many cases the reverse is true. Many can swallow acid or tart food and others only sweetened foods. This must be worked out in the individual case. Again, swallowing is sometimes made easier by hanging the head over the edge of the bed, so that the head is lower than the body, and taking food through a straw (the Wolfenden position). Others are helped by tipping the head backward to a position similar to that used in feeding intubated patients.

Many local treatments are advocated for palliative relief, such as spraying with a solution of cocaine hydrochloride, ethyl aminobenzoate or butyn. For curative use solution of formaldehyde, menthol, chaulmoogra oil, lactic acid, carbon dioxide snow, and old tuberculin all have their advocates.

In my hands, in the early stages general care, absolute rest of the voice and the application of any oily substance to the membrane have given the best results. Lukens [30] has reported favorable results with chaulmoogra oil. It is my opinion that in the early stages there is much more danger of overtreatment than of undertreatment. Indiscriminate swabbing of the larynx, especially with solutions of silver compounds, which produces transudation, may cause abrasions opening new avenues to secondary infection. I have found the injection of alcohol into the superior laryngeal nerve a valuable temporary aid in combating pain. This is a simple procedure well tolerated by even acutely ill patients, and it may be performed at the bedside. Others prefer section of the nerve. Reflection of sunlight into the larynx by means of Verba mirrors is a valuable adjunct to treatment, and some authors report excellent results. However, many patients do not acquire skill enough to direct the rays properly, and those who do tend to overtreat themselves, at times producing sunburn of the larynx. In selected cases, however, under close supervision, it is of value.

---

29. Carmody, T. E., in discussion on Terry.[15]

30. Lukens, Robert M.: Medical Treatment of Laryngeal Tuberculosis, in Jackson, C., and Coates, G. M.: The Nose, Throat, and Ear and Their Diseases, Philadelphia, W. B. Saunders Company, 1929, p. 885.

Wessely [31] in Vienna and Miller,[32] Katz [33] and other authors in this country have reported favorable results by the use of quartz and other types of ultraviolet lamps, the radiation being directed into the larynx largely under direct methods. Most of the patients I have seen do not tolerate direct laryngoscopic examination well, especially when this has to be done repeatedly, and there is also danger of trauma and extension of the tuberculous processes. Roentgen rays and radium have been advocated, but their use is not without danger.

Galvanocautery has been the most valuable agent in treatment. This is carried out under the indirect method in all but exceptional cases. It should be used with caution and for selected patients. I have used it for a swollen and granular epiglottis, granulation, interarytenoid digitation, pale gray edema of the arytenoid cartilages and ulceration. When other methods have failed to give relief from pain, I have even used it in cases of active and acute involvement. Local anesthesia is used, and there is no special preparation of the patient. The amount of cauterization and the frequency of use and the type of cautery depend entirely on the general condition of the patient and the type of lesion present. Ulcers are superficially cauterized. The masses are punctured from one to ten times. This may be done at one sitting or repeated from a few days to several weeks apart. The main point is not to exhaust the patient at any one sitting. The most striking features of cautery puncture are the relatively slight local reaction and the almost constant alleviation of pain. I have had patients ask for repeated cauterization because of the relief from pain. It seems to me that physiologically, the cautery puncture is a correct procedure. It is known that tuberculosis heals by fibrosis. Burns produce scars and frequently excessive scarring, which aids in the healing. The cautery destroys bacteria actually reached and pasteurizes neighboring areas. Greene [34] has shown that the cautery produces an inflammatory reaction, with the development of fibroblasts and new blood vessels in the surrounding tissues. The beneficial effect of the cautery, therefore, extends considerably beyond the local point of application. No attempt is made to destroy all the diseased tissue by the cautery, the aim being only to stimulate this healing process.

---

31. Wessely, E.: A New Method of Treating Tuberculosis of the Upper Air Passages by Local Application of Artificial Light, Wien. klin. Wchnschr. **37**:609 (June 19) 1924.

32. Miller, J. W.: Artificial Sunlight in the Treatment of Laryngeal Tuberculosis, Arch. Otolaryng. **13**:326 (March) 1931.

33. Katz, B.: Ultraviolet Light in Tuberculosis of the Larynx, Arch. Otolaryng. **14**:9 (July) 1931.

34. Greene, Joseph B.: The Electrocautery in the Treatment of Laryngeal and Pharyngeal Tuberculosis, Am. Rev. Tuberc. **10**:73 (Sept.) 1924.

Another procedure I have found valuable is rather out of the laryngologic field. This is collapse of the lung, by phrenic evulsion, pneumothorax, or thoracoplasty. Dworetzky [35] reported a remarkable series of cases in which the frequency of tuberculous laryngitis was lowered to about 0.3 per cent and many patients with tuberculous laryngitis were cured by this procedure. Therefore, if any of the pathognomonic early signs of tuberculous laryngitis are noted, the laryngologist, in cooperation with the specialist in diseases of the lung, should recommend collapse of the lung when it is consistent with the pulmonary stage. Many of my patients had collapse of the lung, but the indications were primarily from the pulmonary standpoint.

I have had 3 cases in which tracheotomy was performed for acute obstruction to breathing, associated in 1 with bilateral paralysis of the abductor muscles and in 2 with subglottic infiltration and massive involvement of the larynx. In every case improvement was noted in the laryngeal disease and also in the condition of the chest. The paralysis, however, was not benefited. Tracheotomy also permitted the radical use of the galvanocautery, which was employed for the relief of pain, in two cases. Tracheotomy is indicated only for marked laryngeal obstruction, but when necessary, secondarily, one can expect improvement of the laryngeal disease.

SUMMARY

The larynx was studied from the clinical standpoint in 452 cases of pulmonary tuberculosis with subjective symptoms referable to the ear, nose or throat. Tuberculous laryngitis was present in 19.2 per cent of the cases. This incidence is somewhat higher than would be expected in the mere routine examination of the larynges of tuberculous patients, without subjective complaints. The stage of involvement of the lungs, social condition, and clinical or pathologic diagnosis must be considered in analyzing the statistics.

In this group only age, sex and pregnancy had any bearing on the development of tuberculous laryngitis. Diseases of the nose and throat were no more frequent in patients with tuberculous laryngitis than in those in whom the disease was limited to the lungs. Tuberculous infection in the larynx usually comes from contact with bacteria-laden sputum, although it is probable that some cases in which the sputum contains no bacilli are lymphatic in origin. A strong local resistance to clinical invasion by the tubercle bacillus was noted in the upper respiratory tract, but no such immunity was noted for other infections. The parasympathetic trophic reflex plays a part in breaking down local resis-

35. Dworetzky, J. P.: Lung Immobilization in the Treatment of Pulmonary Tuberculosis and Its Influence on the Larynx (A Further Report), Tr. Am. Laryng., Rhin. & Otol. Soc. **36**:12, 1930.

tance and offers a reasonable explanation for the fact that tuberculous laryngitis is secondary to pulmonary disease. The pathologic picture is essentially that of tuberculosis elsewhere and is extremely protean, more than one type of lesion occurring in the same larynx and frequently complicating secondary nontuberculous lesions. Subjective symptoms are of little diagnostic value, and the diagnosis is based on the gross observations in the larynx, with the confirmatory observations in the chest and results of laboratory and roentgen study. Prognosis as to healing of the laryngeal lesion in the early stages is good but guarded as to ultimate recovery. Early treatment is based on cooperation with the specialist in diseases of the lungs in the general care, on absolute rest of the voice, on pulmonary collapse in suitable cases and on avoiding overtreatment locally. Occasionally, reflected sunlight is of value in supervised cases. When the lesion is progressive, the radical and repeated use of the galvanocautery is of great worth, care always being taken not to exhaust the patient at any one sitting. Time and temporary relief may be gained by blocking the superior laryngeal nerve.

The actual cautery is well recognized now as a most valuable aid. I feel that its use has been too frequently reserved for patients with far advanced and more or less hopeless conditions. Early use is urged, especially when the condition does not promptly respond to conservative treatment.

Probably in no other field of medicine, with no known specific remedy, has such notable progress been made in combating the incidence and course of a widespread disease as in pulmonary tuberculosis. This is basically the primary focus of laryngeal tuberculosis. Intelligent cooperation between the "phthisician" and the laryngologist will result in equally striking results in the prevention, early diagnosis and successful treatment of this serious complication.

MASKED SINUSITIS AS A CAUSE OF OBSCURE FEVER

ARTHUR R. SOHVAL, M.D.
AND
MAX L. SOM, M.D.
NEW YORK

"Fever of unknown origin" [1] and "habitual hyperthermia" [2] have repeatedly been the subject of discussion in medical literature. Conditions are relegated to these noncommittal categories when all diagnostic resources have been exhausted and the etiology of the fever remains unexplained. Some patients exhibit a relatively short period of pyrexia, of one or more weeks; others maintain continued or intermittent fever for several years. Occasionally, the etiologic diagnosis becomes apparent only after prolonged observation.[1a]

We have recently observed a number of patients with fever of obscure etiology who would have fallen into the aforementioned group had not the paranasal accessory sinuses been thoroughly investigated. Involvement of the sinuses often escapes suspicion if the obscure fever is accompanied by splenomegaly, adenopathy or chills. Only after the usual diagnostic measures have been performed with negative results is attention focused on the upper air passages. In eight cases which we are reporting the diagnosis finally became apparent with the aid of careful examination of the nose and nasopharynx, transillumination, diagnostic irrigation and roentgenographic examination of the sinuses. In one other localizing nasal symptoms ultimately appeared and directed attention to the upper respiratory tract. In each case recovery, usually rapid, ensued when appropriate local therapy was instituted.

From the Medical Service of Dr. George Baehr and the Laryngologic Service of Dr. Rudolph Kramer, the Mount Sinai Hospital.

1. (*a*) Alt, H. L., and Barker, M. H.: Fever of Unknown Origin, J. A. M. A. **94**:1457-1461 (May 10) 1930. (*b*) Kintner, A. R., and Rowntree, L. G.: Long Continued, Low Grade, Idiopathic Fever: Analysis of One Hundred Cases, ibid. **102**:889-892 (March 24) 1934. (*c*) Douthwaite, A. H.: Pyrexia of Obscure Origin, Lancet **1**:1320-1323 (June 8) 1935. (*d*) Perplexing Fevers, editorial, J. A. M. A. **105**:803-804 (Sept. 7) 1935.

2. Finkelstein, H.: Ueber habituelle Hyperthermien, Jahresk. f. ärztl. Fortbild. **21**:1-15 (June) 1930. Feer, E.: Bewegungs- und Konstitutionshyperthermie beim Kinde: Wachstumsfieber, Klin. Wchnschr. **10**:1241-1244 (July 4) 1931. Reimann, H. A.: Habitual Hyperthermia: A Clinical Study of Four Cases with Long-Continued Low-Grade Fever, Arch. Int. Med. **55**:792-808 (May) 1935.

REPORT OF CASES

CASE 1.—S. Z., a 20 year old woman, was admitted to the private pavilion under the care of Dr. Rudolph Kramer. She had been referred because of low grade intermittent fever of three years' duration. Recently there were weakness, fatigue and occasional supra-orbital headache. Repeated physical examinations had failed to disclose any abnormality. The blood count, urine, electrocardiogram and basal metabolic rate were normal. A roentgenogram of the chest was negative. Six months before roentgenographic examination of the sinuses had been reported as showing thickened mucous membrane of both ethmoid regions.

Two months before admission intranasal examination disclosed purulent secretion in the left middle meatus. Irrigation of the antrums produced a moderate amount of granular pus from the left side and small clumps of pus from the right. Although there was subjective improvement, the pyrexia continued and repeated irrigations of both antrums yielded small amounts of granular pus.

To eradicate existing disease in the antrums, bilateral intranasal antrotomy was performed. Thickened mucous membrane was found in each antrum. Postoperative irrigations through the operative ostia were continued until the infection subsided and the return was clear. One week after the operation the fever abated, and the patient remained afebrile for two months. At that time she caught a cold, and the temperature rose to 100.5 F. Irrigation produced a small amount of secretion from the left antrum. She remained afebrile for the five months of observation following this procedure.

This patient had intermittent fever for three years before intranasal examination disclosed the cause. The infection in the antrums had attained such chronicity that operative intervention proved necessary to effect a cure.

CASE 2.—F. B., a 26 year old woman, entered the hospital with intermittent fever, headache, vague aches and pains, cervical lymphadenopathy and splenomegaly of three months' duration. The diagnosis of glandular fever had been made at another hospital. Recently she experienced several shaking chills, considerable fever and profuse sweating. Soreness of the throat appeared on the day of admission.

Physical examination revealed her to be acutely ill, with a temperature of 103.6 F. There were small, nontender nodes in the left posterior triangle of the neck. The firm, nontender edge of the spleen was palpable 1½ fingerbreadths below the costal margin. During a previous admission a few weeks earlier, marked leukopenia was present. The leukocytes numbered only 1,700 per cubic millimeter of blood, although the differential count was normal. However, the blood count soon became and remained normal. The heterophile antibody reaction was negative, and a biopsy performed on a cervical lymph node disclosed only lymphatic hyperplasia on microscopic examination. Urinalysis, blood culture, a roentgenogram of the chest and the sedimentation rate of the erythrocytes showed no abnormality.

Although the possibility of infectious mononucleosis and Hodgkin's disease was considered, no definite diagnosis could be made, and attention was accordingly focused on the upper air passages. The left inferior turbinate was found to be polypoid and covered with mucopus. Mucopurulent secretion was also present in the left portion of the nasopharyngeal vault. The pharyngeal mucous membrane

was studded with inflamed lymphoid nodules. The vocal cords were congested. Transillumination of the maxillary sinuses disclosed the left one to be dark. Irrigation of this sinus produced a large amount of granular pus.

A diagnosis of left maxillary sinusitis and pharyngitis was made. The patient became asymptomatic and afebrile shortly after admission and was discharged six days later. Reexamination at the follow-up clinic, two months later, showed her to be free from symptoms. She had gained 9 pounds (4 Kg.). Her spleen was still palpable.

This patient was admitted on three occasions to two different hospitals before the cause of the prolonged intermittent fever, chills, adenopathy and splenomegaly was discovered. The findings pointed predominantly to a disturbance in the lymphoid or the hematopoietic system, but confirmatory evidence was continually lacking. Diagnostic lavage of one antrum not only established the diagnosis but was evidently sufficient to terminate the symptoms.

CASE 3.—Eight weeks before admission to the hospital, R. S., a 9 year old boy, had fever, with a temperature of 105 F., vomiting and malaise. For three days the temperature ranged between 100 and 104.8 F. Examination gave entirely negative results except for the presence of enlarged nontender cervical glands on the right side. The blood count at first revealed relative lymphocytosis and mononucleosis, with a normal total number of leukocytes. The picture was suggestive of that seen in infectious mononucleosis. Another blood count about three weeks later was normal. The heterophile antibody reaction was normal. After that daily fever, with the temperature ranging from 99.6 to 101.5 F., persisted. Dizziness on motion of the head, slight generalized headache, anorexia, loss of weight and insomnia appeared during the last few weeks. The neurologic status was entirely normal. Roentgenographic examination of the chest and spine and urinalysis gave negative results. A roentgenogram of the sinuses showed clouding of the right antrum.

Examination at the end of seven weeks of fever revealed a sallow appearance, discrete, nontender lymph nodes in both submaxillary regions and questionable tenderness over the right antrum. Both inferior turbinates were edematous; the left ethmoid region was congested, and stringy pus was present in the right middle meatus. A few remnants of adenoids were present. Discrete lymphoid tissue was present in the posterior pharyngeal wall. Transillumination showed the right antrum to be cloudy.

The patient was given vasoconstricting nasal sprays and steam inhalations for one week without effect on the temperature. Reexamination disclosed the intranasal status to be unchanged. Another roentgenogram of the sinuses now showed clouding of both antrums. The mucous membrane of the left ethmoid labyrinth was thickened.

At the end of the eighth week of fever the patient was hospitalized for the purpose of irrigating the antrums. This procedure produced a moderate amount of thick mucopus from both sides. Staphylococcus aureus was cultured from the irrigated secretions. The temperature promptly fell to 98.6 F. for the first time since the illness began and failed to exceed 99.6 F. for the next five days, during which he gained 5 pounds (2.26 Kg.). The temperature rose to 100.4 F. on the sixth day. Irrigation on the following day yielded a smaller amount of mucopus. Intermittent fever with the temperature reaching 100 F. was present for the next two weeks, at the end of which period irrigation was again performed. The

return from the right side was now clear, while that from the left contained a few flakes of mucopus. A roentgenogram of the sinuses now showed both antrums to be clear. Slight thickening was still present in the left ethmoid region. For the three months of observation prior to the time of writing he has been afebrile and asymptomatic, and he is rapidly gaining weight.

This 9 year old child had continuous fever for eight weeks, with little or no clinical evidence specifically pointing to sinus disease. Recognition and treatment of the latter resulted in a prompt, although temporary, disappearance of the fever. Repeated irrigations were necessary to effect a complete cure.

CASE 4.—About seven weeks prior to admission to the hospital, H. O., a 42 year old man, had "grip" and a sore throat. The temperature became normal in four days, although he continued to have pain in the back. During the five weeks prior to admission he had continuous fever, the temperature ranging up to 103 F., frontal headache and backache. For the last three days there was considerable pain in the right lumbar region, worse on deep breathing.

The patient appeared chronically ill and pale, and his temperature was 101.4 F. There was congestion of the pharynx, and mucopus dripped from the nasopharynx. Moderate tenderness was present in the costovertebral angles, especially the right.

Because of the pain in the loins and the fever, the diagnosis of renal carbuncle was held most likely. The urine contained a slight amount of albumin and occasional leukocytes and erythrocytes. However, cultures of the urine and blood contained no organisms. Roentgenograms of the genito-urinary tract and chest were negative. An electrocardiogram showed only a tendency to left ventricular preponderance. The blood count was normal. The sedimentation time of the erythrocytes was twenty-three minutes.

Despite the absence of definite symptoms which would draw attention to the nose and throat, a rhinologic consultation was requested. The nasopharyngeal mucous membrane was inflamed. The adenoid tissue was boggy and covered with mucopus. Mucopus was irrigated from the left sphenoid sinus. Culture yielded Staph. aureus. Treatment with steam inhalations and vasoconstricting nasal sprays was immediately instituted, and the patient reported marked improvement. A roentgenogram of the sinuses showed slight clouding of the right antrum and possibly similar slight clouding of the left antrum. There was evidence of thickening of the lining membrane. There was a diffuse clouding of the ethmoid regions on both sides, with absorption of the intercellular septums on the left and of the entire ethmoid capsule on the right.

The patient was discharged asymptomatic on the eleventh day and advised to return for intranasal spheno-ethmoidectomy and maxillary sinusotomy. One month following discharge he reported continued freedom from symptoms.

This patient with pansinusitis had fever, frontal headache and backache for five weeks. The headache had been erroneously interpreted as the accompaniment of fever. There were no additional symptoms pointing to disease of the accessory nasal sinuses. Final recognition and therapy of the etiologic process resulted in prompt recovery.

CASE 5.—M. O., a 17 year old girl, was seen at home on several occasions because of intermittent fever for four weeks, the temperature ranging up to 103 F. Her only other symptoms were malaise and vague "drawing sensations" in the

calves. Physical examinations gave entirely negative results. The blood count and the sedimentation time were normal. Electrocardiograms were made on two occasions and were normal. Fluoroscopic examination of the chest revealed no abnormality. At the end of the fourth week slight frontal headache developed, and she began to vomit after her meals.

At that point the upper air passages were examined. The nasal mucous membrane was congested. The right inferior turbinate was edematous, and its posterior tip was polypoid. Transillumination showed clouding of the right antrum. Diagnostic irrigation of the antrum produced thick pus from the right side and flaky mucopus from the left. Staphylococcus aureus was present on culture. After this procedure the fever promptly subsided, and she continued to be afebrile for the remaining three months of observation. At that time irrigation of the right antrum yielded a few flakes of mucopus, while the return from the left side was clear.

In this instance, intermittent fever was present for four weeks without any clinical evidence to indicate an infection of the sinuses. Experience with other cases in this group prompted an investigation of the sinuses, which resulted in immediate diagnosis and rapid recovery.

CASE 6.—B. T., a 29 year old man, entered the hospital complaining of fever, with the temperature ranging up to 102 F., chilliness, malaise and transient migrating aches in various muscles and joints.

He did not appear acutely ill, and the temperature was 101.2 F. The firm, nontender edge of the spleen was palpable 2 fingerbreadths below the costal margin. In other respects general physical examination gave negative results.

The blood count, the sedimentation rate of the erythrocytes, two blood cultures, urinalysis and culture of the urine, a roentgenogram of the chest and an electrocardiogram revealed no abnormality. A roentgenogram of the sinuses was likewise normal.

Examination of the nose and throat disclosed a small amount of secretion in the left middle meatus. The tonsils were embedded, and from them purulent material could be expressed. Diagnostic irrigation of the left antrum produced a moderately large amount of inspissated pus. Culture of the secretion yielded Staph. aureus and Streptococcus viridans. After the irrigation of the antrum, the patient became afebrile. Reirrigation five days after the first lavage yielded only a small blood-tinged clump of mucopus.

A tonsillectomy was subsequently performed because of continued aches of the muscles and joints; the spleen became impalpable and the patient was discharged as well. He reported himself to be free from symptoms three months later.

For two weeks this patient had continuous fever with vague pains in the muscles and joints. The presence of an enlarged spleen rendered the diagnosis more obscure. Despite the normal roentgen findings and the absence of nasal symptoms, diagnostic irrigation of the antrum was performed. In this instance, this procedure was therapeutic as well as diagnostic.

CASE 7.—Except for occasional frontal headaches during the past year, M. K., a 12 year old boy, was perfectly well until five days prior to admission to the hospital. At that time he had a shaking chill for an hour. The next day a

headache developed in the right frontal region, radiating to the right occiput and thence to the left side of the head and the back of the neck. This headache persisted unchanged. There were also pains in the thighs and groins.

The patient was bright and alert and did not appear ill, despite the temperature of 102.8 F. There was slight nuchal resistance. Shotty nodes were present in both posterior triangles of the neck. Nodes the size of peas were present in both axillae and groins, the latter being tender. The tip of the spleen was palpable at the costal margin on deep inspiration.

The diagnosis of infectious mononucleosis was held likely, but the blood count and heterophile antibody reactions were normal. Encephalitis was considered, but the absence of significant neurologic signs and the normal spinal fluid made this diagnosis untenable. Blood culture, urinalysis, the Widal test and a roentgenogram of the chest revealed no abnormal condition. The sedimentation time of the red blood cells was twelve minutes. The laryngologic service was requested to examine the patient and found evidence of an acute infection of the upper respiratory tract, despite the absence of definite suggestive symptoms. A roentgenogram of the sinuses showed clouding of the right ethmoid cells.

Without any particular treatment the patient improved. Concurrently the nasal condition subsided. Transillumination showed the antrums to be clear. Nevertheless, irrigation of the right antrum and the right sphenoid sinus was performed, and a few flakes of mucopus were obtained from each.

The patient was discharged well at the end of four weeks. The small lymph nodes noted at the time of admission became still smaller; the sedimentation time was normal, and the spleen was no longer palpable. On examination, four months later, he reported occasional frontal headaches, but no fever or chills. He still had slight glandular enlargement.

This patient had fever and headaches for twelve days before the nature of the illness was recognized. Slight resistance of the neck, slight general adenopathy and a palpable spleen drew attention to the neurologic and lymphatic systems. Repeated observation of the nasopharynx, roentgenograms of the sinuses and diagnostic irrigations established the diagnosis, which otherwise would not have been made in the absence of symptoms directly referable to the nose and its accessory sinuses.

CASE 8.—R. Z., a 27 year old woman, had suffered from frequent frontal and occipital headaches for the ten years prior to examination. She believed these headaches to be related to the use of the eyes. Four days before admission to the hospital there developed a similar but more severe headache associated with photophobia and fever, the temperature ranging between 100 and 103 F. Two days later her throat became sore.

Examination disclosed the patient to be acutely ill, with a temperature of 103 F. The firm, nontender edge of the spleen was palpable 2 fingerbreadths below the costal margin. A number of small pink maculopapules were scattered on the abdomen, flanks and shoulders.

Because of the severe cephalalgia, fever and eruption, the diagnosis of endemic typhus was considered. However, the Weil-Felix reaction was negative on two occasions, and the course was not typical. A blood count, two blood cultures and urinalysis gave negative results. The spinal fluid was under normal pressure and showed no abnormalities.

Thin secretion was present in both nasal cavities, with slight thickening of the middle turbinates. Thick secretion was present in the pyriform fossa. There was tenderness over the entire head, particularly over the antrums. The history and local appearance were considered suggestive of sinusitis. Irrigation of the sphenoid sinuses produced numerous small flakes, especially from the left side. During the irrigation the patient complained of her usual type of headache. Steam inhalations and vasoconstricting nasal sprays were given, and she soon became free from symptoms and afebrile. Irrigation of the antrums was then carried out, and a moderate number of mucopurulent shreds were obtained from both sides, particularly the right. Reirrigation two days later revealed only a small amount of mucopus from both antrums and both sphenoid sinuses. A roentgenogram of the sinuses showed slight clouding of the left antrum. The left sphenoid sinus was also slightly clouded.

The patient made an uneventful recovery, and the spleen became impalpable.

Diagnostic lavage of the sinuses in this case produced the same type of headache from which the patient had suffered for the previous ten years. This indicated a chronic undiagnosed sinus infection. A recent exacerbation, or extension, without additional localizing symptoms was responsible for the fever and enlarged spleen. The acute illness would likewise have remained undiagnosed if the possibility of sinus disease had not been ultimately considered.

CASE 9.—E. F., a 22 year old woman, had a history of nasal obstruction and discharge for five years. During the past three years she had frequent frontal headaches. In the three months prior to admission to the hospital she had numerous attacks of chills and fever. Each episode began with low grade fever in the morning, the temperature rose to 102 F. or 103 F. in the evening and was followed by repeated teeth-chattering chills, each lasting for several minutes. Fever continued all night, and the patient usually felt well in the morning. These attacks occurred at intervals of two weeks and were not accompanied by any respiratory symptoms other than the usual coryza and cough which she had had for several years. No cause for the chills and fever had been found. Ten days before admission she noticed enlarged tender nodes on each side of the neck. There was no soreness of the throat. On the day of admission she had a shaking chill for an hour (the third in three days) and a rapid rise of temperature to 104.8 F. There were semistupor, severe headache, dizziness and vomiting.

Physical examination disclosed that the patient was acutely ill, with a temperature of 102.4 F. The entire nasal mucous membrane was injected. There was mucopus in the right middle meatus, the spheno-ethmoid recess and the nasopharynx. The pharynx and the vocal cords were injected. Digital pressure over the right frontal and maxillary sinuses caused considerable pain. The upper deep cervical nodes were enlarged and tender. The remainder of the physical examination gave essentially negative results. There were 17,000 leukocytes per cubic millimeter of blood, of which the polymorphonuclear cells constituted 84 per cent.

A diagnosis of acute pansinusitis on the right side was made, and the patient was given steam inhalations and vasoconstricting nasal sprays. Within forty-eight hours the temperature dropped to and remained normal, and she was comfortable. One week after admission both antrums were irrigated. A large amount of thick creamy purulent material was obtained from the right side. The return from

the left side contained a few flakes of mucus. A large amount of thick pus was washed out from the right sphenoid sinus. Four days later a moderate amount of pus was again irrigated from the right antrum and a few shreds of pus from the right sphenoid sinus. She was afebrile and asymptomatic during the last ten days of her stay in the hospital.

The cause of the chills and fever in this case remained undiagnosed for three months and finally became apparent only when an acute exacerbation of chronic sinusitis led to an investigation of the sinuses.

COMMENT

This communication deals with sinusitis as a cause of certain obscure febrile illnesses, often prolonged, in which localizing symptoms referable

Clinical Summary of Cases

Case	Age	Sex	Duration of Fever Before Sinuses Were Investigated	Previous Diagnoses	Chills	Enlarged Spleen	Enlarged Lymph Nodes	Leukocytosis	Rapid Sedimentation Rate
1	20	F	2½ yr.	None	0	0	0	0	..
2	26	F	3 mo.	Infectious mononucleosis	+	+	+	0	..
3	9	M	7 wk.	Infectious mononucleosis	0	0	+	0	..
4	42	M	5 wk.	Renal carbuncle	0	0	0	0	+
5	17	F	4 wk.	Rheumatic fever	0	0	0	0	0
6	29	M	2 wk.	Cryptogenic sepsis; subacute bacterial endocarditis	0	+	0	0	0
7	12	M	12 days	Infectious mononucleosis; encephalitis	+	+	+	0	+
8	27	F	7 days	Endemic typhus	0	+	0	0	..
9	22	F	3 mo.	None*	+	0	+	+	..

* Specific localizing symptoms referable to the nose or sinuses ultimately developed and directed attention to this area.

to the accessory sinuses are lacking. Unless the possibility of sinus infection is borne in mind, the cause of the pyrexia remains unexplained, and the unsatisfactory diagnosis "fever of unknown origin" is generally made.

Our patients were generally in the early decades of life. The duration of the fever (intermittent in the more prolonged cases) before the accessory nasal sinuses were investigated and found to be infected varied between one week and two and one-half years. Previous tentative diagnoses included infectious mononucleosis, rheumatic fever, bacterial invasion of the blood stream, subacute bacterial endocarditis, carbuncle of the kidney, epidemic encephalitis and endemic typhus fever. It is of interest that infectious mononucleosis was considered in two instances because of a palpable spleen and enlarged lymph nodes and

in a third because of relative lymphocytosis and mononucleosis in the blood. In no case were the heterophile antibody reactions positive.

Shaking chills were present in three cases, lymphadenopathy in four and an enlarged spleen in four. The spleen was never enlarged more than 2 fingerbreadths below the costal margin. It became impalpable within two weeks in cases 6 and 8 but continued to be enlarged at the end of two months in case 2 and at the end of four months in case 7. Enlargement of the lymph nodes was slight, occurring in the cervical region in four cases. In case 7 there was also pea-sized enlargement of the axillary and inguinal glands.

Chills, lymphadenopathy and splenomegaly were the most important misleading clinical findings. These generally diverted attention from the upper air passages and delayed the final diagnosis. The rather frequent occurrence of such systemic manifestations is consistent with an infection unproductive of localizing symptoms.

Leukocytosis was present in only one instance and temporary leukopenia in another of the nine cases, whereas the erythrocyte sedimentation time was accelerated in two of the four cases in which the test was performed.

The intranasal examination and management of these patients merits special discussion. The rhinologist must be cognizant of the fact that disease of the paranasal sinuses (latent or manifest) may be the sole causative factor in the production of such obscure clinical syndromes. Without such realization he may not attribute proper significance to the intranasal findings, which at times may be scant. The classic intranasal manifestations of sinus suppuration—streaks of purulent secretion in the regions of the natural orifices of the accessory sinuses, tenderness of the bone over the sinuses and polypoid degeneration of the turbinates—were only exceptionally encountered in our cases. Less striking but equally significant findings are localized changes in the texture of the turbinal mucosa: congestion, edema and hyperplasia and the presence of adherent purulent secretion. Occasionally, the intranasal examination reveals insufficient evidence for the diagnosis of sinus disease, which is, nevertheless, present.

Transillumination performed under well controlled conditions is a valuable aid in the diagnosis of disease of the maxillary sinus. The diminution or absence of the pupillary red reflex on either side warrants further investigation of the antrum. On the other hand, transillumination occasionally fails to show cloudiness despite the presence of proved infection.

Roentgenologic examination frequently reveals cloudiness of one or more of the diseased sinuses. Thickening of the lining membrane and absorption of intercellular septums are occasionally found. However, close correlation between pathologic and roentgenologic findings

does not necessarily exist, and consequently too much reliance must not be placed on the latter. In fact, the roentgenogram may fail to disclose known sinus disease.

Irrigation is the most reliable method of establishing the presence of infection in the paranasal sinuses. Diagnostic lavage of the antrums or sphenoid sinuses with a sterile, warm solution of sodium chloride through the natural orifices is an innocuous, painless procedure. By means of the Yankauer cannula, the ostia of these sinuses can be located in the vast majority of cases.

The character of the return fluid after irrigation is most important in demonstrating the presence of sinus infection. Irrigation of a normal paranasal sinus, after preliminary cleasing of the nasal chambers with the aid of suction, should yield a clear, transparent return. On the other hand, infection is present when the return flow contains granular or inspissated purulent secretion. An opaque fluid with mucopurulent secretion or flakes is indicative of disease, and no less significance should be attributed to it. A purulent cast of the sinuses or a large quantity of pus is not always to be expected on irrigation. When subacute sinusitis exists, the lining mucosa may become markedly thickened and encroach on the cavity of the sinus, so that only a limited amount of exudate at most can be harbored there. On the other hand, the diseased mucosa may not be sufficiently thickened to diminish the capacity of the sinus, yet irrigation may yield but a small quantity of mucopurulent secretion. Furthermore, the amount of pus obtained at any one irrigation is partially dependent on the interval elapsing after the contents of the sinus had been spontaneously decreased either by ciliary action and other normal evacuative processes or by vigorously blowing the nose and sneezing. Infrequently, an opaque return is caused solely by a suspension of the infecting organisms.

Roentgenographic examination and transillumination may give entirely negative results, yet irrigation may reveal suppuration in the maxillary or the sphenoid sinus. Similarly, the intranasal examination may disclose few objective manifestations of sinusitis, while diagnostic lavage may yield a purulent return.

Culture of the irrigated secretion frequently shows Staph. aureus. This organism was obtained in four of the cases (cases 3, 4, 5 and 6) in which the secretion was cultured. In one case (case 6) Str. viridans was also present.

A single irrigation may be not only diagnostic but therapeutic as well. This was true in cases 2, 4, 5 and 6, in which fever permanently abated after lavage. Prompt but temporary cessation of pyrexia ensued in case 3, in which repeated irrigations were necessary to effect a cure. In case 1 repeated irrigations failed to eradicate the disease and intranasal antrotomy was necessary.

While irrigation is possible in the diagnosis and treatment of disease of the maxillary and sphenoid sinuses, it is not applicable in the management of ethmoiditis. In such instances it is necessary to resort to vasoconstricting nasal sprays and steam inhalations to promote better spontaneous drainage. However, in the presence of associated maxillary sinusitis, ethmoiditis usually responds more promptly after the antral infection has been cleared up.

The nine cases are reported because they lacked definite symptoms pointing to sinusitis. Inspection of the case histories, however, reveals the presence of headache in every instance except case 6. The location was frontal in five cases, not specified in two and supra-orbital in one. In each case (except case 9, in which specific localizing symptoms referable to the sinuses ultimately developed and directed attention to this area) the headache had been regarded as a nonspecific manifestation of the febrile state and little attention was paid to it. It was not until the diagnosis of sinusitis was proved that the true significance of the cephalalgias was appreciated in retrospect. Of interest in this connection was the reproduction of the typical occipital headache in case 8 by lavage of the sphenoid sinus. The patient had suffered from this type of headache for ten years, but it had been attributed to an ocular condition.

CONCLUSIONS

Patients with fever of obscure or "unknown" etiology, especially those with headache, should as a routine have a roentgenographic examination of the paranasal sinuses, intranasal examination and diagnostic irrigation of the sinuses.

Sinusitis was established as the cause of obscure fever in nine cases. The disease in the sinuses was masked in general by the absence of localizing symptoms on the one hand and the presence of misleading constitutional manifestations on the other.

The diagnosis and management of patients with masked sinusitis are discussed.

940 Park Avenue.

121 East Sixtieth Street.

OTITIC MENINGITIS WITH RECOVERY

SYLVIO A. SCIARRETTA, M.D.
CHICAGO

A review of the literature of the past twenty years discloses an enormous amount of material indicating the many possibilities of the clinical course in cases of septic meningitis of otitic origin when recovery takes place.[1] An additional report of such a case is justifiable in view of the fact that recovery is rarely reported after surgical intervention confined to the temporal bone and its adnexa.[2]

PATHOGENESIS

Infection [3] from the temporal bone to the meninges takes place: first, by way of the auditory nerve, terminating at the internal auditory meatus;[4] second, by direct continuity of structures, either tegmentally to the cerebral fossa or by way of Trautmann's triangle to the posterior fossa;[5] third, through persisting sutures and dehiscences;[6] fourth, through the petrous pyramid, as described by Eagleton,[7] Friesner,[8] Kopetzky and Almour[9] and others; fifth, through the aquaeductus cochlearis or the ductus endolymphaticus[6] and sixth, through vascular

---

Presented as a candidate's thesis to the Chicago Laryngological and Otological Society, October 1934.

1. Yerger, C. F.: Meningitis of Otitic Origin, J. A. M. A. **79**:1924 (Dec. 2) 1922. Rosenberg, L., and Nottley, H. W.: Recovery from Streptococcic Meningitis, Ann. Int. Med. **4**:1154 (March) 1931.

2. Appelbaum, E.: Streptococcic Meningitis: Recovery of Three Cases, J. A. M. A. **98**:1253 (April 9) 1932.

3. Gatewood, W. L., and Settel, N.: Routes of Infection in Otogenous Meningitis, Arch. Otolaryng. **18**:614 (Nov.) 1933.

4. Druss, J. G., and Friesner, I.: Pathways of Infections in Abscess of the Brain: Report of Five Cases, Arch. Otolaryng. **13**:532 (April) 1931.

5. Neuman, H.: Der otische Kleinhirn-Abszess, Vienna, Franz Deuticke, 1907, p. 49.

6. Wittmack, K.: Die entzündlichen Erkrankungsprozesse des Gehörorganes, in Henke, F., and Lubarsch, O.: Handbuch der speziellen pathologischen Anatomie und Histologie, Berlin, Julius Springer, 1926, vol. 12, p. 380.

7. Eagleton, Wells P.: Unlocking of the Petrosal Pyramid for Localized Bulbar (Pontile) Meningitis Secondary to Suppuration of the Petrous Apex, Arch. Otolaryng. **13**:386 (March) 1931.

8. Friesner, I., and Druss, J. G.: Osteitis of the Petrous Pyramid of the Temporal Bone, Arch. Otolaryng. **12**:542 (Sept.) 1930.

9. Kopetzky, Samuel J., and Almour, Ralph: The Suppuration of the Petrous Pyramid, Ann. Otol., Rhin. & Laryng. **39**:996, 1930; **40**:157, 396 and 922, 1931.

routes—arterial,[10] venous [11] and lymphatic.[12] Eggston [13] recently summarized the various routes of infection in suppurative meningitis due to all causes.

PATHOLOGIC PICTURE

Meningitis of otitic origin occurs most frequently after an acute suppurative process, whether the mastoiditis is of the coalescent or the osteophlebitic variety. These are usually infections of a streptococcic nature.

Septic meningitis associated with chronic suppuration of the middle ear and the mastoid occurs least frequently. When it occurs, it is usually a localized septic process of a serous protective type and the cerebrospinal fluid does not contain micro-organisms.

A third type of septic meningitis of otitic origin occurs in acute exacerbation of chronic otitis media and mastoiditis,[14] especially when the type III pneumococcus or Streptococcus haemolyticus is the offending organism. This type of septic otitic meningitis is usually the most fatal.

It is necessary to differentiate as to the degree and type of osteal disease of the temporal bone in the individual case in order to prognosticate the course of the meningitis. For example, simple chronic otitis with fistulous tracts and granulation tissue will behave differently from a condition in which true cholesteatoma is present.

It must be emphasized that syphilitic osteitis [15] not infrequently is coexistent with chronic suppuration. A preexisting gumma in these regions will play an important rôle in the course of an acute exacerbation of the suppurative process. Tuberculous osteitis [16] of the temporal bone is comparatively rare in chronic suppuration of the middle ear.[17] It

---

10. Pietrantoni, L.: Methods of Propagation of Middle Ear Infections to the Petrosal Apex, Cavernous Sinus, and Abducens and Gasserian Ganglion: Venous Routes, Arch. ital. di otol. **38**:296, 1927.

11. Ruskin, S. L.: The Venous Circulation of the Petrous Bone and Its Clinical Significance, Ann. Otol., Rhin. & Laryng. **42**:961 (Dec.) 1933.

12. Turner, A. L., and Reynolds, F. E.: Intracranial Pyogenic Diseases, Edinburgh, Oliver & Boyd, 1931.

13. Eggston, A. A.: Pathways of Infection in Suppurative Meningitis, Ann. Otol., Rhin. & Laryng. **43**:672 (Sept.) 1934.

14. Eagleton, Wells P.: Otitic Meningitis, J. A. M. A. **87**:1544 (Nov. 6) 1926.

15. Jackson, Chevalier, and Coates, G. M.: The Nose, Throat and Ear and Their Diseases, Philadelphia, W. B. Saunders Company, 1929, p. 710.

16. Politzer, A.: Diseases of the Ear, revised by Milton J. Ballin, ed. 6, Philadelphia, Lea & Febiger, 1926, p. 463.

17. Turner, A. L., and Fraser, J. S.: Tuberculosis of the Middle Ear Cleft in Children: A Clinical and Pathological Study, J. Laryng., Rhin. & Otol. **30**:209, 1915.

may, however, also influence an acute flare-up. Both these specific infections will modify the course of otogenic meningitis.

The presence of a neoplasm, particularly epithelioma, in a chronic suppurative process has an important bearing on the development of septic meningitis. It is frequently a forerunner of the malady but has a tendency toward an insidious onset unless an acute exacerbation supervenes.

This pathologic entity can scarcely be classified from the traumatic point of view. Yet trauma with subsequent hematoma, especially as an accompaniment of basal fractures in the presence of suppuration of the middle ear, must be considered as an important factor in the development of meningitis.

In this communication I desire to emphasize that a patient with septic meningitis may recover in spite of a positive clinical diagnosis of diffuse labyrinthitis or petrositis, although operation has been performed neither on the labyrinth nor on the petrous bone. There is sufficient evidence on record, however, that when labyrinthotomy or petrosotomy has been performed in such cases the patients have been spared meningitis and all its complications.

DIAGNOSIS

The question may be propounded as to whether there is a definite method of determining that an operation on the labyrinth or the petrous bone would avert threatening meningitis or cure existing meningitis. I believe that a meticulous study of the cerebrospinal fluid [18] from every angle—chemical,[19] bacteriologic,[20] cytologic [21] and physical analysis—is of greater assistance in solving this problem than any other factor. Clinicians have called attention to the dangers attendant on spinal puncture, such as draining off too much fluid and breaking up protective adhesions.[22] This claim should not deter one from examination of the spinal fluid, because only a small amount of fluid is required for the aforementioned examinations.

---

18. Peters, J. P., and Van Slyke, D. D.: Quantitative Clinical Chemistry, Baltimore, Williams & Wilkins Company, 1932, vol. 2.

19. Glaser, J.: The Lactic Acid Content of Spinal Fluid, J. Biol. Chem. **69**: 539, 1926.

20. Neal, J. B.; Jackson, H. W., and Appelbaum, E.: A Comprehensive Study of Meningitis Secondary to Otitic or Sinus Infection, Ann. Otol., Rhin. & Laryng. **43**:658 (Sept.) 1934.

21. Levene, P., and Meyer, G.: The Action of Leucocytes on Glucose, J. Biol. Chem. **11**:361, 1912.

22. Jenkins, G. J.: Some Points in the Treatment of Meningitis, J. Laryng. & Otol. **44**:239 (April) 1929.

The chemical reaction [23] is of great value in making an early diagnosis [24] and determining the severity of the infection.[25] Early disappearance of the copper reaction is of prime importance. The Lange gold curve for meningitis is shown very early in severe forms of septic meningitis. The Nonne-Apelt test is also important when positive results are obtained.

As stated before, the exact identification of the micro-organism found in the fluid, especially in growth rather than in smears, is the most important point indicating surgical intervention on the labyrinth or the petrous pyramid, the mastoid operation having been previously performed and the clinical picture of a dead labyrinth and petrositis established.[26] Unfortunately, the therapy employed at this stage is generally not effective.

The cell count and the type of cells found in the spinal fluid give important information and should never be overlooked.[27] The physical properties of the fluid are not of particular value in indicating surgical intervention, nor is the extreme pressure, which merely indicates that the ependyma is reacting.

One is surprised in reading the varied reports of the bacteriologic findings in the examination of the spinal fluid. For example, the presence of both gram-positive and gram-negative bacteria in the same specimen may be reported, the organism may be found in the smear and not in the culture or a cloudy spinal fluid without organisms may be noted. The existence of such confusion can easily be explained by the bacteriologist and is not generally appreciated by the clinician. It was with this in mind that Tobey,[28] in his presidential address before the American Otological Society, suggested the appointment of a committee for the investigation of otitic meningitis in all its phases in order that more lives might be saved and that the method of treating true otogenic meningitis might be improved.

TREATMENT

While the petrous pyramid was mentioned as a possible source of septic meningitis and in a limited number of cases operations on this

23. Osnato, M., and Killian, J. A.: Significant Chemical Changes in the Spinal Fluid in Meningitis, Arch. Neurol. & Psychiat. **15**:738 (June) 1926.

24. Kopetzky, Samuel J., and Fishberg, E.: Early Diagnosis in Meningitis, Arch. Otolaryng. **16**:851 (Dec.) 1932.

25. Kopetzky, Samuel J.: Meningitis: Nature, Cause, Diagnosis, and Principles of Surgical Relief, Tr. Am. Laryng., Rhin. & Otol. Soc. **18**:116, 1912.

26. Williams, A. W.: Bacteriology of Meningitis Following Otitis Media and Related Infections, Ann. Otol., Rhin. & Laryng. **43**:667 (Sept.) 1934.

27. Kopetzky, Samuel J.: Otologic Surgery, New York, Paul B. Hoeber, Inc., 1929, p. 431.

28. Tobey, G. L.: Presidential Address, Tr. Am. Otol. Soc. **23**:37, 1933.

structure have been performed to prevent the progress of meningitis, the pathologico-anatomic material (postmortem) is insufficient to be of positive assistance. During the past three years Voss,[29] Frenckner,[30] Ramadier,[31] Kopetzky and Almour [32] and others [33] have reported the employment of various surgical technics in a reasonable number of such cases.

Forced drainage as indicated by Kubie [34] is a procedure that is still in the experimental stage, but its employment will give the surgeon more time to determine what procedure to follow.

The intracarotid treatment for meningitis originated by Kolmer [35] has been tried, and its results, so far, are encouraging but not sufficient to establish a new method for the cure of a specific type of meningitis. A number of instances of cure have been reported by Kolmer,[36] Crawford [37] and Ersner.[38]

Statistics [38] seem to prove that more cures have been obtained by the removal of the primary focus of infection (a complete mastoidectomy) and by exposure of the dura, at times aided by repeated spinal taps.[39]

---

29. Voss, O.: Pyramidenspitzeneiterungen (Petrositis) an der Hand von selbstbeobachteten Fällen, Acta oto-laryng. **15**:469, 1931.

30. Frenckner, P.: Some Remarks on the Treatment of Apicitis (Petrositis) With or Without Gradenigo's Syndrome, Acta oto-laryng. **17**:97, 1932.

31. Ramadier, J.; Guillon, H., and Becker: Etude anatomique d'une voie d'abord des cellules de la pointe du rocher, Ann. d'anat. path. **9**:597, 1932.

32. Kopetzky, Samuel J., and Almour, Ralph: Empyema of the Petrous Apex: Further Observations and Case Reports, Ann. Otol., Rhin. & Laryng. **42**:802 (Sept.) 1933; Problems Concerned with Anatomy, Pathology and Surgical Treatment of Suppuration of Petrosal Pyramid, Arch. Otolaryng. **19**:143 (Jan.) 1934.

33. Antognoli, G. C.: Latero-Cervical Fistula from Osteitis of the Cranial Base in a Patient Affected by Tubercular Mastoiditis, Valsalva **9**:834 (Nov.) 1933.

34. Kubie, L. S.: Intracranial Pressure Changes During Forced Drainage of the Central Nervous System, Arch. Neurol. & Psychiat. **16**:319 (Sept.) 1926; Forced Drainage of the Cerebrospinal Fluid in Relation to the Treatment of Infections of the Central Nervous System, ibid. **19**:997 (June) 1928. Kubie, L. S., and Retan, G. M.: Forced Drainage of the Cerebrospinal Fluid: Its Experimental Basis, the Technic of Clinical Application and the Indications and Contraindications, J. A. M. A. **101**:354 (July 29) 1933; Forced Drainage for the Treatment of Meningitis Secondary to Ear and Sinus Infections, Ann. Otol., Rhin. & Laryng. **43**:692 (Sept.) 1934.

35. Kolmer, J. A.; Rule, Anna M., and Madden, Bernard: Chemotherapy and Serum Therapy of Pneumococcus and Streptococcus Meningitis: Intracarotid Treatment for Experimental Pneumococcus Meningitis, Arch. Otolaryng. **9**:509 (May) 1929.

36. Kolmer, J. A.: Intracarotid Method of Treatment for Meningitis, with Recoveries, J. A. M. A. **96**:1358 (April 25) 1931.

37. Crawford, A. S.: The Intracarotid Treatment of Meningitis, J. A. M. A. **98**:1531 (April 30) 1932.

38. Ersner, M. S., and Mendell, T. H.: Streptococcic Meningitis with Intracarotid Treatment and Recovery, J. A. M. A. **99**:1596 (Nov. 5) 1932.

39. Hempstead, B. E.: Treatment of Otitic Meningitis, Ann. Otol., Rhin. & Laryng. **40**:542 (June) 1931.

The serologic treatment is yet in its experimental stage, but bacteriologists are hopeful of furnishing another great specific to combat this dreaded complication.[40]

REPORT OF A CASE

The following history was obtained from the physician and intern in attendance.

Mrs. Alice M. K., aged 26 and moderately well nourished, was brought to the hospital in an ambulance on Dec. 14, 1930, at 9:15 p. m. The essential signs and symptoms on admittance were as follows: temperature 102 F., pulse rate 72 and respiratory rate 20. Terrific shooting pains in the head began above and posterior to the left ear, radiated to the temporal region of that side and then spread over the entire cranium. There were intermittent nausea, vomiting and chills. She complained of pain in the back of the neck and the spine. Delirium alternated with brief periods of rationality. The removal of spinal fluid improved the condition for a few hours, but later all symptoms became aggravated and the general condition became alarming.

Five days before her hospitalization the patient was seized with severe buzzing in the left ear and nausea. An otologist was consulted, who cleansed and medicated the ear and prescribed a saturated solution of boric acid in alcohol to be dropped in it three times a day. The following morning she had some relief, but the nausea was still present; however, she went to work. On the third day she returned to the otologist. This time the treatment was painful, and considerable blood oozed from the ear. During the night the pain increased considerably, and toward morning she had very severe pains, beginning over the left mastoid area and radiating in all directions throughout the head. The pain became progressively worse, and in a few hours she became nauseated; later persistent vomiting set in. Toward evening a profuse discharge from the left meatus appeared. The family physician was called, and he prescribed internal medication and an ice bag on the head. The condition improved slightly, but by the following afternoon it was so critical that she was removed to the hospital.

Examination of the blood at that time revealed: erythrocytes 3,400,000, hemoglobin 60 per cent, color index 0.88 and leukocytes 9,600. The differential count showed: polymorphonuclears 68 per cent, lymphocytes 17 per cent, large mononuclears 10 per cent and eosinophils 5 per cent. The spinal fluid was slightly cloudy, containing 1,450 cells per cubic millimeter; no micro-organisms were found. The superficial otoscopic examination revealed only a profuse purulent discharge from the left ear.

On the evening of December 15 (twenty-four hours after admission) I was called in consultation. The patient was acutely ill and was difficult to examine because she was irrational and drowsy. For brief periods her mind became clear, and during these intervals she was cooperative and answered questions intelligently. From the mother, who was present, the following additional points of interest relative to the previous history were obtained.

At the age of 6 years, the patient had a severe attack of scarlet fever, during which a discharge from the left ear developed. After this, she had pharyngeal diphtheria, which responded to diphtheria antitoxin. While she was convalescing, bronchopneumonia developed, which was complicated by pleurisy with effusion. The chest had to be aspirated three times. She regained normal health after

40. Kolmer, J. A., and Amano, K. W.: The Specific Prophylaxis of Pneumococcus and Streptococcus Meningitis, Arch. Otolaryng. **14**:125 (Aug.) 1931.

three months, and the left ear became dry. One year later she was seized with severe pain in the left ear, which subsided on the instillation of drops of warm olive oil into the auditory canal.

When she was 9 years old, she had another severe attack of earache; the discharge was profuse and persisted until it became foul. Her mother took her to the family physician, who prescribed drops for the ear and assured the parent that she did not need to worry because her child would outgrow this condition.

From the age of 9 to 14 the patient had occasional headaches with periodic reappearance of discharge and slight deafness. During the interval from 14 to 26 years of age total deafness developed in the left ear. The discharge during this period became yellow, foul and so profuse that the cotton placed in the auditory meatus had to be changed two or three times a day. At that time, while walking, if she turned her head quickly in a certain direction (she could not recall whether to the left or the right), she became dizzy and had the sensation of falling, and nearby objects seemed in motion. Her general physical condition, except as already stated, and the family history were essentially negative.

My examination at that time disclosed the following: The head was turned to the right and buried in the pillow. The patient kept her eyes closed on account of photophobia and vertigo. The temperature was 101.4 F., the pulse rate 78 and the respiratory rate 20. The neck was rigid, and the Kernig and Babinski signs were positive.

The right ear was normal; the spoken and whispered voice were heard about 20 feet (6 meters). The left external auditory canal was filled with thick foul-smelling pus, and when this was wiped away the outline of the margins of the tympanic membrane could be identified; granulations and necrotic tissue were clearly seen filling the tympanum. In this, the left side, the hearing was totally absent; with the right ear masked, a loud voice on contact could not be heard. The patient had a spontaneous nystagmus to the right (healthy side). It was deemed inadvisable to carry out the caloric and rotatory tests and tests for symptoms of fistula owing to the patient's critical condition.

Roentgenograms of the mastoids showed sclerosis in the region of the antrum on the right side, but the peripheral cells were clear and normal; on the left, complete sclerosis was present, especially in the region of the tegmen tympani, and an area of rarefaction, probably a cell, was noted in the tip of the mastoid.

The throat appeared normal. The nose was free from any pathologic changes. The roentgen study of the nasal accessory sinuses showed no involvement.

A second laboratory examination was ordered, and the following reports were obtained: The urine was essentially normal. A smear of the pus from the left ear showed gram-positive diplococci, staphylococci, pseudodiphtheria bacillus and fusiform bacilli. The Wassermann reaction was negative. Examination of the blood showed: erythrocytes 3,510,000, hemoglobin 58 per cent, color index 0.82 and leukocytes 12,600. The differential count showed: polymorphonuclears 87 per cent, lymphocytes 10 per cent and large mononuclears and transitionals 3 per cent. The spinal fluid appeared turbid, and the pressure was slightly increased over that noted at the first examination; the cell count was 2,650 per cubic millimeter, and the differential count showed polymorphonuclears 64 per cent, lymphocytes 32 per cent and endothelial cells 4 per cent. Both the smear and the culture revealed a gram-positive diplococcus. It was most unfortunate that at this point contamination of the material occurred, and subculture could not be carried on for further study.

Immediate surgical intervention was decided on owing to the presence of an acute exacerbation of a foul discharge from the ear of twenty years' duration, practically a total loss of hearing of the affected side, positive roentgenographic findings, moderate leukocytosis and elevation of temperature, progressive decrease of hemoglobin and red cell count and also evidence of labyrinthine irritation—nausea, vomiting, vertigo, spontaneous nystagmus and position of the head—plus the positive meningeal involvement indicated by severe headache, photophobia, delirium, rigidity of the neck, a positive Kernig and Babinski sign and the presence of organisms and an increased cell count in the spinal fluid.

The operation performed was a radical mastoidectomy. The entire mastoid process was found to be eburnated. The lateral sinus was only 7 mm. behind the posterior wall of the bony canal. The antrum was filled with pus and granulation tissue. The cavity was thoroughly cleaned out. The posterior part of the canal was lowered, and the bridge was removed. The middle ear was entered and carefully curetted of all the granulations; only a small fragment of the incus was found. When the field was well dried, a large area of necrotic bone was found, extending from the region of the facial canal to the attic; this bone was carefully removed, and the underlying dura thus exposed appeared injected but otherwise healthy. This tegmental opening was enlarged, and all pathologic bone was removed, leaving a denuded area of about 2 cm. in circumference. The sigmoid portion of the lateral sinus was exposed for about 1.5 cm. and appeared normal. After the Koerner plastic flap was sutured and the exposed sinus and dura were covered with iodoform gauze, the wound was packed and closed completely.

By the following noon the patient was rational and retained fluids well. The Kernig and Babinski signs were absent, and the cervical rigidity was much diminished. The pain in the head persisted, but it was less severe. The nystagmus to the healthy side was still present. The temperature rose to 100 F. every evening for the first three postoperative days, after that it remained normal.

On the third postoperative day, December 18, the iodoform strips were removed, and plain gauze was placed in the canal; after this procedure all the pain in the head vanished. The spontaneous nystagmus on the fifth day changed to the rotary type to both sides; on the twelfth day it disappeared. The patient left the hospital on the thirteenth day in good condition. The wound epidermized completely in five weeks, and she had, to her surprise, recovered a small amount of hearing. In the right ear the spoken and whispered voice were heard at 20 feet (6 meters) and in the left ear the spoken voice was heard at 10 feet (3 meters) and the whispered voice at 14 inches (35.5 cm.) with the right ear masked. In 1936 the patient reported that she felt well. The ear was in excellent condition.

SUMMARY OF CASE

An acute exacerbation of chronic suppurative otitis media manifesting transient signs of labyrinthine irritation is reported.

The existence of meningeal infection was proved by the presence of gram-positive diplococci in the spinal fluid.

The infection was carried into the cranial fossa per continuitatem.

The recovery is attributed to the wide surgical exposure of the dura and removal of a portion of the perilabyrinthine cells.

CONCLUSION

In spite of the immense amount of laboratory experiments and clinical research by distinguished workers, it will not be denied that the number of instances of recovery from true septic meningitis of otitic origin is comparatively small.

The enormously varied therapeutic methods employed in treating septic meningitis proves that there is no rational, clearly defined and generally accepted plan of treatment which in any large series of cases can be depended on.

Otitic septic meningitis is more common than is generally thought. It would be less frequent if prophylactic measures were more rigidly adhered to by the early and adequate treatment of suppuration of the middle ear.

A positive diagnosis of septic meningitis can frequently be ascertained, during its incipient stage, by the judicious use of the various laboratory examinations. It is probable that if the therapeutic measures were employed at an early period more recoveries from septic meningitis could be recorded.

55 East Washington Street.

CEREBROSPINAL RHINORRHEA

DAVID H. BALLON, M.D.
Otolaryngologist in Chief, Royal Victoria Hospital
AND
H. C. BALLON, M.D.
Assistant Surgeon, Jewish General Hospital
MONTREAL, CANADA

The escape of cerebrospinal fluid from the nose, usually referred to as cerebrospinal rhinorrhea, may be consequent to trauma or new growth, or it may be spontaneous. Its occurrence after a fracture of the skull requires no discussion, for under such circumstances it is frequently possible to demonstrate the opening through which the cerebrospinal fluid leaves the skull. When the cause is new growth, it may or may not be possible to demonstrate both the mechanism and the pathway. Thus, in a recent publication entitled "Rhinorrhea and Neoplasms of the Central Nervous System," Britt [1] stated that he was unable to demonstrate how the fluid escaped from the nose in one instance. In another it was suggested that a midline tumor of the cerebellum had produced internal hydrocephalus and that the increased pressure had resulted in erosion of the lamina cribrosa. Britt noted that tumors situated in the region of the pituitary gland and the posterior fossa are more often responsible for rhinorrhea than are those situated elsewhere in the brain.

Sir St. Clair Thomson [2] did not include Miller's [3] case (1826) in his monograph "The Cerebro-Spinal Fluid; Its Spontaneous Escape from the Nose," first published in 1899. There is an element of doubt as to whether the nasal discharge in the aforementioned case was cerebrospinal fluid. Nevertheless, it is worthy of note that necropsy in Miller's case revealed a foramen to the right of the crista galli which admitted four bristles. The dura mater was missing at this point.

Sir St. Clair Thomson was the first to appreciate that a spontaneous discharge of cerebrospinal fluid from the nose can occur. In the years that have elapsed since the appearance of his monumental treatise on

---

1. Britt, R. E.: Rhinorrhea and Neoplasm of the Central Nervous System, J. Nerv. & Ment. Dis. **81**:654, 1935.

2. Thomson, St. Clair: The Cerebro-Spinal Fluid: Its Spontaneous Escape from the Nose, with Observations on Its Composition and Function in the Human Subject, New York, William Wood & Company, 1901.

3. Miller, C.: Case of Hydrocephalus Chronicus, with Some Unusual Appearances on Dissection, Tr. Med.-Chir. Soc. Edinburgh **2**:243, 1826.

the subject little has been added to knowledge of the condition. From Thomson's publication we found that Tillaux in 1877 reported a case of an optician who presented himself for examination during December 1872. This man had twice been operated on for nasal polypi. The amount of flow in this case was calculated at 0.25 liter in the day. This patient died with convulsive symptoms. Leber in 1883 reported a case of hydrocephalus with postneuritic atrophy of the optic nerves and persistent dropping of watery fluid from the nose. Toison and Lenoble in 1891 also reported a case. In this patient's history mention was made of an injury to the neck four years previously. F. Wallace Mackenzie in 1892 reported "A Case of Atrophy of the Optic Nerves with Dropping of Watery Fluid from the Left Nostril." In his comment on this case Sir St. Clair Thomson stated that Mackenzie expressed the opinion that the fluid came from the subarachnoid space. He stated: "I look upon the early symptoms and condition as being analogous to an attack of glaucoma, and the relief caused by the escape of fluid through the nose may be compared to the relief of the increased tension in the eye by the escape of fluid through the canal of Schlemm." In this case headache, failure of vision and "fainting fits" ceased entirely on the establishment of the flow. In Gutsche's case (1895) death ensued on the fifty-eighth day after the first appearance of the illness. "The post-mortem showed struma pituitaria (swelling of the pituitary gland and of the chiasma nervorum opticorum), empyema of the sphenoidal sinuses and of the left maxillary antrum, and arachnitis purulenta." Sir St. Clair Thomson appreciated that there might be some objection to considering Gutsche's case as an instance of spontaneous cerebrospinal rhinorrhea. Mermod reported a case in 1896. The complaints of the patient in this case were painful tickling in the nose and mucopurulent secretion. This patient had much running from the nose and suffered considerably from headache. The headache diminished after an abundant nasal evacuation of liquid, which was as clear as water. Mermod attempted to catheterize the sinuses and tried to penetrate the frontal sinus from the nasal cavity. Meningoencephalitis developed, and the patient died shortly after. Mermod stated:

> At the post-mortem, examination of the skull revealed the existence of two holes. The first hardly perceptible, was situated in the dura mater, beside the apophysis crista galli, and more than three centimetres behind the nasal spine. It was probably through this small slit that the flow of liquid used to take place. The second opening was much further forward in the neighbourhood of the foramen caecum, and two millimetres behind the posterior surface of the bony wall or eleven millimetres from the nasal spine and at least one centimetre in front of the lamina cribrosa, which had not been injured. No trace of a frontal sinus was to be found either on the right or left side. The brain showed no sign of

traumatism. At the base, around the optic chiasma and cerebellum, there was a considerable quantity of pus in the subarachnoid spaces, otherwise the base of the brain showed no sign of inflammation. On the right a focus of softening of the point of the frontal lobe invaded the two first frontal convolutions. The ventricles were very dilated and occupied with purulent serum; the ependyma was very injected and opaque. On the right the first frontal presented on section some small haemorrhages in the white matter; the centre of softening only concerned the grey matter.

Sir St. Clair Thomson stated that his case would rank in chronological order as seventh. The patient was a healthy-looking single woman of 25. She was first observed in April 1896. Two and a half years previously she had noticed a tendency to dripping from the left nostril. This dripping had been continuous both day and night but had occasionally stopped for periods as long as a month. Some post-nasal growths were scraped away on May 20, 1896, but the dripping continued as before. With the exception of slight congestion along the margin of the left middle turbinate, the inside of the nasal fossa was found to be normal. A complete examination of the nervous system showed no abnormality. In the past history mention was made of an attack of headache and vomiting which had confined her to her bed for fourteen days, some four years previously. It was also stated that she had had "fits," but she was never observed in any of these attacks. Headaches, which had been a prominent feature, ceased to trouble her after the fluid began to drip from the left side of her nose. Dr. Hewlett and Professor Halliburton both established the fact that it was cerebrospinal fluid. It was sterile. The patient was apparently last observed on March 18, 1899, when the escape of fluid was reported to be as bad as ever. Her eyesight remained unimpaired. A small polypus, "presumably an oedematous fibroma," had formed and was descending from the left middle turbinate and the septum.

Sir St. Clair Thomson was able to collect the records of twenty-one cases, in many of which the condition was associated with cerebral symptoms and in some with retinal changes. Nine were considered as undoubted instances of cerebrospinal rhinorrhea.

In Scheppegrell's (1898) case the striking features were recurrent headache, each attack being relieved by the discharge through the right nostril of fluid from the cranial cavity. Korner's patient was of low mental capacity. The underlying condition was apparently a tumor of the pituitary body. Sir St. Clair Thomson gave the following summary of the nine undoubted instances of cerebrospinal rhinorrhea collected by him. The sexes appear to be fairly equally affected. The condition appears to be a disease of youth and adult middle life. The discharge is more frequently unilateral than bilateral, and although there may be intermission in the flow, in no instance did it disappear.

In 1905 Schwab and Green [4] stressed the association of retinal changes with cerebrospinal rhinorrhea. They were able to collect ten such cases, including one of their own. They made reference to some of the cases collected by Thomson and also to Freudenthal's case. Schwab and Green stated that in all cases the ophthalmoscopic pictures were strikingly similar: either a full-blown optic neuritis passing into atrophy or typical postpapillitic atrophy. The pupils were usually dilated, reacting feebly to stimulation by light. In five instances the visual fields were examined and found to be contracted. The only instance of determination of the fields for colors was that reported by Nettleship. He found the field for green much contracted, while that for red almost equaled the field for white. The visual outcome in five cases was bare perception of light or total blindness. In four instances the greater visual defect was noted in the eye on the same side as the nasal flow. Failure of vision preceded the establishment of the flow in seven cases, the interval being from one to five years. On three occasions the flow began several years before the onset of ocular symptoms.

Schwab and Green expressed the opinion that ocular changes in these cases are probably not accidental but an integral part of the disease, of which they form one part and the escape of the cerebrospinal fluid another.

REPORT OF A CASE

A man aged 53 first came under our care early in January 1934. His complaints were right frontal headache, cough, "head cold," insomnia and a feeling of weakness in the morning. All these complaints were of two weeks' duration and were said to have made their appearance after exposure to inclement weather.

In the past history there was mention of an automobile accident two years previously, when the patient received an injury to his head. This was followed by headache, which soon cleared up. About one year previous to the onset of his present illness he had noticed a clear watery discharge from his nose. The discharge ceased after four weeks. In 1930 he was ill with so-called catarrhal jaundice. The family history is irrelevant.

Examination.—The most striking feature of the condition was the costant drip of clear fluid from the right nostril. The patient regarded this as a "head cold." It was possible to collect about 12 cc. of this fluid in ten minutes. The flow was faster when he leaned forward. On questioning it was learned that the clear fluid which escaped from his right nostril was at times tasteless but on most occasions salty. It did not stiffen his handkerchief, nor did it stain it. There was no tenderness over the nasal sinuses, which were roentgenologically clear. The cough was apparently occasioned by the fluid which dropped down his throat. A fluoroscopic examination of the chest revealed clear pulmonary fields, with a heart of normal configuration. The blood pressure was 150 systolic and 90 diastolic. He was afebrile. It was his opinion that the insomnia was occasioned by the

4. Schwab, Sidney I., and Green, J.: A Case of Cerebro-Spinal Rhinorrhoea with Retinal Changes, Am. J. M. Sc. **129**:774, 1905.

nasal drip, which kept on continuously throughout the night. Direct examination of the nose failed to reveal the cause for the nasal discharge. There was no limitation of the visual fields, but the pupils were rather small and reacted sluggishly to light and in accommodation. The general physical examination otherwise gave negative results. The nature of the nasal discharge, a clear fluid, the absence of local findings to account for it, and the fact that the fluid did not stiffen a handkerchief all pointed to a diagnosis of cerebrospinal rhinorrhea. This diagnosis was confirmed when the fluid was found to be alkaline and free from large quantities of albumin or pus cells, and particularly since it gave a strong reduction of Fehling's solution. The continuous discharge of cerebrospinal fluid readily explained the headache and fatigue. The blood picture was normal, and the urine was free from albumin, sugar and blood. To our surprise, the Wassermann reaction of the blood was strongly positive. The cerebrospinal fluid collected from the nose and sent for examination at the same time gave a negative Wassermann reaction.

Quantitative studies of protein, sugar and chlorides in the nasal discharge were subsequently made by Dr. J. F. McIntosh of the Royal Victoria Hospital. He reported that the fluid contained: protein, 100 mg. per hundred cubic centimeters; sugar, 0.44 mg. per hundred cubic centimeters; chlorides, 448.4 mg. of chloride per hundred cubic centimeters, and 7.4 Gm. of sodium chloride per liter. Microscopic examination showed a few epithelial cells. The findings indicate a normal cerebrospinal fluid. The protein content is twice normal—possibly explained by the cellular content or by some other contaminant in minute traces.

Treatment and Course.—The patient was cautioned against the use of any medication in his nose. Roentgenograms of the skull later repeated by Dr. Pirie were all normal. He was also seen by Dr. Penfield, who advised surgical intervention. The patient refused this, as he did antisyphilitic treatment. Not long after this he had an attack of abdominal pain, suggestive of renal colic. Repeated examination of the urine and roentgen ray studies of the genito-urinary tract gave negative results. Gastric crises then seemed the logical explanation for the pain.

Five months after the onset of symptoms the flow of cerebrospinal fluid from the nose ceased. It had not returned when the patient was last heard from a few months ago. It is too soon, and past experiences have indicated that it would be unwise, to conclude that the flow will not start again. It is not unlikely that the previous attack of rhinorrhea, which persisted for four weeks, may have been cerebrospinal rhinorrhea.

Comment.—This case is undoubtedly an instance of spontaneous cerebrospinal rhinorrhea. It is unfortunate that the patient would not submit to a lumbar puncture or to antisyphilitic treatment. Surgical intervention was also considered, but it was likewise refused by the patient. The condition was first noted in our patient at a later period in life than is usually expected. He has remained free from ocular signs. As in other cases, it has been clinically impossible to demonstrate an opening through which the cerebrospinal fluid escaped from the skull. The flow was obviously not from the nasal mucous membrane itself, so that the possibility of nasal hydrorrhea has been eliminated. The nature of the fluid and the negative local findings excluded the likelihood that we were dealing with vasomotor rhinitis.

Sir St. Clair Thomson expressed the opinion that until more is known about the pathologic picture of the condition it is best to refrain from any direct attempt to check the flow. "Against the intra-nasal medication I would venture to particularly urge a warning." Feinblatt and Damrau [5] employed pituitary extract intranasally and expressed the opinion that it contributed to the arrest of the flow in their case. On one occasion Learmonth [6] turned back a flap above the forehead and then elevated the right frontal lobe into its covering of dura, backward and mesially until the region of the cribriform plate came into view. "This was found to be occupied by vascular granulation tissue." Between this granulation tissue and the dura he inserted four packs soaked in tincture of iodine. The packs were removed one by one, the last one nine days after the operation. There was no discharge of cerebrospinal fluid through the nose until some days later. Learmonth stated: "This is not discouraging since it takes about six weeks to produce the maximal amount of scarring of the dura." In the discussion of this report Lillie stated: "The above is the third case of its kind which has been reported with successful operation."

SUMMARY

A case is reported of "spontaneous" cerebrospinal rhinorrhea in a man aged 53 whose blood gave a positive Wassermann reaction. Reference is made to the important treatise on the subject by Sir St. Clair Thomson. The frequent association of ocular symptoms already noted by Thomson, Schwab and Green is again stressed. It is hoped that late results, particularly those in a case in which an operation has been carried out, will be published.

---

5. Feinblatt, H. M., and Damrau, F.: Cerebrospinal Rhinorrhea: Report of Case and Review of Literature, M. Rec. **139**:324, 1934.

6. Learmonth, J. R.: Cerebrospinal Rhinorrhea Treated by Operation, Proc. Staff Meet., Mayo Clin. **4**:115, 1929.

NEURO-OTOLOGIC STUDIES IN EPILEPSY

EDWIN J. BLONDER, M.D.
CHICAGO

Neuro-otologic examinations were conducted on sixty-three patients suffering from epilepsy who entered the Passavant Memorial Hospital for intensive study. Among these there were forty-three with idiopathic and twenty with organic epilepsy. The examinations consisted of otoscopic study, tests for hearing of the whispered and spoken voice and for labyrinthine function by studies of caloric nystagmus and past pointing, using water at 68 F., and by the galvanic falling test, a recently described clinical application of this reaction.[1] In these reports a large series of patients who reacted to galvanic falling while standing on a balance board were described. In my series of normal persons, generally from 1 to 3 milliamperes of galvanic current and rarely 5 milliamperes was necessary to produce falling. Labyrinths inactive to caloric stimulation failed to react to a large amount of galvanic current (20 milliamperes).

Of the sixty-three patients examined for hearing, fifty-five (87 per cent) responded normally. This compares well with the results of Langdon,[2] who reported normal hearing in 85 per cent of thirty-five patients with epilepsy, and differs from those obtained by Jones,[3] who found no cochlear defects in twenty-seven such patients.

In twenty-nine patients, nine with organic and twenty with functional epilepsy, tested for galvanic falling, caloric nystagmus, past pointing, and hearing, eighteen (62 per cent) were found to have normal vestibular and auditory functions. In sixty-one patients tested for hearing, vestibular function was determined by caloric nystagmus, galvanic falling or both; forty-five (73.7 per cent) reacted with normal vestibular and auditory responses. Sixteen were classified as having abnormal vestibular function because of falling produced by 0.5 milli-

---

Otologist to the Department of Nervous and Mental Diseases, Northwestern University Medical School, the Minnie Frances Kleman Memorial Fund.

1. Blonder, E. J.: Galvanic Falling in Clinical Use, Arch. Neurol. & Psychiat. **37**:137 (Jan.) 1937. Blonder, E. J., and Davis, Loyal: The Galvanic Falling Reaction in Patients with Verified Intracranial Neoplasms, J. A. M. A. **107**:411 (Aug. 8) 1936.

2. Langdon, E. E.: Symposium on the Eighth Nerve: Neuro-Otologic Studies in Epilepsy, Laryngoscope **45**:70 (Jan.) 1935.

3. Jones, I. H.: Neurotologic Studies in Epilepsy, J. A. M. A. **81**:2083 (Dec. 22) 1923.

amperes or because of an onset of caloric nystagmus in less than thirty seconds. These results differ from those of Jones,[3] who found that all his twenty-seven patients with epilepsy had some vestibular defect.

Sixty-two patients suffering from epilepsy were examined for vestibular function. The caloric and galvanic tests were performed on fifty-four, the caloric test on one and the galvanic falling test on seven. Sixty-one (98 per cent) had active labyrinths. In four, however, the labyrinths reacted bilaterally to 0.5 milliamperes of galvanic current and required less than thirty seconds for the onset of caloric nystagmus and so were considered hyperactive. Marked visceral responses were not present. In all the caloric examinations the irrigation was discontinued immediately on the onset of nystagmus. One patient with functional epilepsy who had slightly impaired hearing showed a failure of reaction to the caloric and galvanic stimulation of one labyrinth. The opposite labyrinth responded normally. Neurologic examination of other systems failed to confirm the presence of a central lesion. Jones and Spiller[4] reported similar findings in the ears of a patient who on postmortem examination was found to have degeneration in the pons and the medulla.

Caloric irrigation with water at 68 F. in twenty-nine persons with epilepsy, twenty with functional and nine with the organic type, revealed that eighteen (62 per cent) had normal past pointing. Of the eleven patients with abnormal responses, five had organic epilepsy and six had functional epilepsy. Of the patients with abnormal past pointing, one of whom had ocular nystagmus, five reacted with indefinite past pointing, while the sixth had only one active labyrinth. Both ears of this patient responded to tests for hearing. Three patients with organic epilepsy failed to past point with one arm after irrigation of one of the ears; one failed to past point with either arm on irrigation of either ear, and one responded markedly by past pointing a few feet with one arm. Neurologic examination disclosed no evidence to account for the defective past pointing except hemiplegia in one instance. In contrast to the findings in this series, Langdon[2] found abnormal past pointing in 57 per cent of thirty-five cases.

The onset of caloric nystagmus in fifty-five epileptic persons was in from fifteen to ninety seconds in all except one with traumatic epilepsy, who required three and one-half minutes, and one with functional epilepsy, who required two minutes. Only three patients with bilaterally active labyrinths varied ten seconds or more in the onset of the caloric nystagmus between the two labyrinths. The epilepsy in two of these was classified as functional and in one as traumatic. The

4. Jones, I. H., and Spiller, W. G.: The Central Tracts of the Nervus Vestibularis, Brain **48**:334, 1925.

average onset of the caloric nystagmus in forty-three patients with functional epilepsy was thirty-seven and one-half seconds and in twelve with organic epilepsy, forty-three and eight-tenths seconds.

In fifty-three patients, stimulation with from 0.5 to 4 milliamperes of galvanic current produced falling. Six required 5, one 8 and one 20 milliamperes, but the tendency to fall was present with much less current. The average amount of galvanic current required for falling (not including the markedly abnormal 20 milliampere reading) was 2.4 milliamperes, of which there was an average difference of only 0.1 milliampere between the patients with functional epilepsy and those with organic epilepsy.

Three patients whose blood bromides varied from 225 to 300 mg. required only 1 milliampere to produce falling; one with 225 mg. required 3 milliamperes. This indicates that in these patients bromides failed to affect this vestibular response. Langdon [2] noted that phenobarbital failed to depress vestibular responses. Ross, Fish and Olsen [5] reported that in animals bromides reduced vestibular responses to rotation by about 10 per cent.

Spontaneous nystagmus was present in one case. This compares favorably with the observations of Standin,[6] who reported only infrequent nystagmus in patients with epilepsy.

No patient had an epileptic attack during or as a result of the caloric and galvanic tests. One patient showed myotonic contractions of an extremity after caloric irrigation, but no loss of consciousness. Jones,[3] Rabinowitsch [7] and Scheinmann,[8] however, have reported attacks incited by the caloric and rotation tests.

CONCLUSIONS

The neuro-otologic examination of patients suffering from epilepsy revealed defects in past pointing in 37 per cent of a group of twenty-nine, peripheral defects of hearing in 10 per cent of sixty-three, hyperactive labyrinths in 6 per cent of sixty-four, and one instance of a suspected defect of the central vestibular pathway. No findings common to or characteristic of any group of these patients were present.

185 North Wabash Avenue.

5. Ross, E. L.; Fish, M. W., and Olsen, A.: Effects of Some Drugs on the Vestibular Response to Rotation, Arch. Otolaryng. **14**:755 (Dec.) 1931.

6. Standin, K. H.: Epilepsie und Vestibularapparat, Arch. f. Psychiat. **101**: 761, 1934.

7. Rabinowitsch, J. S.: Epilepsie und Vestibular System, Monatschr. f. Psychiat. u. Neurol. **70**:94, 1928.

8. Scheinmann, cited by Rabinowitsch.[7]

RECOVERY FROM ABSCESS OF THE FRONTAL LOBE SECONDARY TO EMPYEMA OF THE SPHENOID SINUS

ABRAHAM KAPLAN, M.D.
NEW YORK

Intracranial complications following infection of the sphenoid sinus are not uncommon. In a review of the experiences with disease of the nasal sinuses at the Cook County Hospital between 1911 and 1920, inclusive, Yerger [1] found that although the sphenoid sinus is less frequently diseased than the other sinuses, it nevertheless is more often responsible for intracranial complications. Thus, of a total of 393 cases of sinusitis studied there were 11, or 2.8 per cent, in which the pathologic condition involved the sphenoid sinus. Of these 11 cases, intracranial complications developed in 7, or 63 per cent.

That such complications are frequently not suspected is evident from the fact that of the 7 cases in which such complications developed the diagnosis was made at autopsy in 5, disease of the sphenoid sinus was suspected before symptoms of meningitis set in in only 1 and the diagnosis was made at operation in 1. None of the patients recovered.

In a study of 1,268 cases of acute and chronic suppuration of the accessory sinuses, Maxwell [2] found intracranial complications in 22 patients, or 1.7 per cent. In only 3 of the 22 cases was a cerebral abscess found, but none related to the sphenoid sinus.

Lischkoff,[3] after a thorough survey of the literature, found only 5 cases of abscess of the brain secondary to sphenoid sinusitis. He reviewed these in great detail and added an excellent report of a sixth case. In 2 of these 6 cases, McBean's [4] and Bombelli's,[5] exploration

---

From the Neurosurgical and Neurological Services of Mount Sinai Hospital.

1. Yerger, C. F.: Intracranial Complications of Suppurative Sphenoid Sinus Disease, Illinois M. J. **43**:304 (April) 1923.

2. Maxwell, David: Analysis of Statistical Tables in Ear, Nose and Throat Department of Royal Infirmary, Edinburgh, J. Laryng. & Otol. **44**:105 (Feb.) 1929.

3. Lischkoff, M. A.: Latent Brain Abscess Secondary to Sphenoid Sinusitis, with Case Report, South. M. J. **28**:700 (Aug.) 1935.

4. McBean, G. M.: Variations of Sphenoid Sinus Disease, Ann. Otol., Rhin. & Laryng. **23**:419 (June) 1914.

5. Bombelli, Ugo: Un case di ascesso cerebrale da sinusite sfenoidale latente in paziente affetta da gravi complicanze ottiche, Riv. oto-neuro-oftal. **5**:142 (March-April) 1928.

was performed in search for a pathologic process in the brain. Both patients died, and in each case autopsy disclosed a cerebral abscess and suppuration in the sphenoid sinus only. In the cases reported by Yerger,[1] Druss,[6] Kramer [7] and Lischkoff [8] so few neurologic signs were present that a cerebral abscess was not even suspected. The changes noted at autopsy in these cases were particularly instructive, because they exhibited the most frequent pathway of infection from the sphenoid cavity into the cranium.

The following report of an instance of suppuration of the sphenoid sinus complicated by an abscess of the frontal lobe is singular not only because the disease of the sphenoid was correctly recognized and adequately treated but because in spite of the few neurologic signs a cerebral abscess was anticipated, found and successfully drained. As far as can be ascertained this is the first instance on record in which the patient fully recovered from this serious condition.

REPORT OF A CASE

Infection of the upper respiratory tract, bitemporal headaches not relieved by drainage of maxillary sinus, epistaxis; pain in right eyeball; early papilledema; hypalgesia of right side of face, ataxia; sphenoidectomy disclosing empyema of right sphenoid; advance in papilledema; ventriculography revealing location of lesion; drainage of abscess of frontal lobe; complete recovery.

History.—On Feb. 25, 1935, Louise H., a housewife aged 20, was referred to the Mount Sinai Hospital by Dr. Nathan Savitzky because a cerebral neoplasm or abscess of the brain was suspected. The past history was essentially unimportant.

The illness started two months before admission, when the patient suddenly felt a "chilly" sensation, and the temperature rose to 101 F. A few days later she began to complain of bitemporal headache, which was followed by pain in the right ear. The pain in the ear subsided without treatment, but the headaches continued.

Three weeks after the onset of the illness there was transient stiffness of the neck for two days. The maxillary sinuses were opened at that time, and a slight amount of purulent material was found on the right but none on the left. This procedure in no way relieved the headaches, which by this time had become so severe that the patient consumed as many as twelve tablets of acetylsalicylic acid daily for several weeks, with only temporary benefit. During this period she had mild fever, the temperature never rising over 101 F. She vomited only once.

The headaches continued, became throbbing and were referred to the mid-occipital region. Sudden changes in posture particularly aggravated the head pains.

A week before admission there were two severe epistaxes. At that time the pains in the head again shifted and were referred to the region of the right side of the forehead and behind the right eyeball. These symptoms were accompanied by diplopia. The patient lost 17 pounds (7.7 Kg.).

---

6. Druss, J. G.: Intracranial Complications Associated with Disease of the Sphenoid Bone, Arch. Otolaryng. **10**:39 (July) 1929.

7. Kramer, R.: Intracranial Complications Following Sphenoid Infections, Laryngoscope **39**:573, 1929.

At various times during the illness the objective findings were so few and fleeting that the complaints were explained on a psychogenic basis.

At no time were there any convulsions, palsies, sensory disturbances, hallucinations of taste, odor or light, or disturbance in gait. Mentality and character showed no alteration.

Examination.—The patient was a well developed, alert young woman, apparently comfortable, rather facetious and inclined to joke and laugh about her illness, although she realized that there was something seriously wrong with her.

General physical examination gave negative results. The blood pressure was 105 systolic and 65 diastolic. The neurologic examination showed the head slightly tilted to the left and tenderness to percussion over the right frontal and malar regions. No alteration in olfactory sense was noted. The vision was 20/20 in the right eye and 20/25 in the left eye. The right pupil was smaller than the left, both reacting promptly to light and in accommodation. Examination of the fundi revealed blurred margins of the disks but no measurable elevation. The visual fields showed no defect, although there was definite enlargement of both blindspots. Ocular movements were normal in all directions. Occasionally there could be demonstrated some hyperalgesia of the right side of the face, but no inequality of the corneal reflexes was noted. In spite of the tendency for the tongue to deviate to the left, facial weakness was not present. The gait was slow and unsteady, with a tendency to sway to the right. The right foot was everted. Slight ataxia was present, as shown by raising the left finger to the nose. The knee and suprapatellar reflexes were more lively on the left. The Hoffmann sign was positive on the left, but the Chaddock and Rossolimo reflexes were obtained on the right only. The Babinski sign was doubtful on both sides. The abdominal responses were equally brisk.

Laboratory Data.—The leukocyte count was 9,200, with 66 per cent neutrophils and 30 per cent lymphocytes. The red cells numbered 4,500,000 per cubic millimeter. The hemoglobin content was 85 per cent. The spinal fluid was clear and colorless, with a pressure of 200 mm., and showed 34 lymphocytes per cubic millimeter. The Pandy test gave negative results.

Course in Hospital.—Roentgenograms taken three days after the patient's admission to the hospital showed moderate clouding of the left antrum, the left ethmoid sinus and both frontal sinuses. The sphenoid sinuses appeared well aerated. Roentgenograms of the skull, however, showed increased convolutional markings.

A few days after admission the patient was observed to have a weakness of the right external rectus muscle, which led to an investigation of the nasal accessory sinuses. This was performed on March 2, 1935, by Dr. Rudolph Kramer, who found thick creamy pus in the right sphenoid sinus and a small quantity of pus in the left sphenoid sinus. Culture of the pus showed a growth of Staphylococcus aureus. The impression at that time was that of empyema of the sphenoid sinus, with probable abscess of the frontal lobe.

In the two days that followed this operation the temperature rose to 103.8 F., and the occipital headaches became more pronounced. The fundi showed advancing papilledema, and a Babinski sign was noted on the right. A day later the temperature was 102 F. and the headaches were less, but the pain behind the right eyeball returned.

Improvement was slow. A week after the sphenoidectomy the left ear drum appeared full and bulging, with the landmarks all gone. Myringotomy was performed, and pus was obtained, which on culture showed a growth of Streptococcus haemolyticus.

Within the next fortnight the headaches subsided; the papilledema began to recede, and the left ear was greatly improved. The spinal fluid, however, was under a pressure of 420 mm., and though it was clear and colorless, it still showed 32 lymphocytes per cubic millimeter.

Encephalography was performed on March 25, 1935; 95 cc. of fluid was removed from the lumbar space, and 80 cc. of air was injected. Roentgenograms showed no air in the left ventricle, but the air that entered the right lateral ventricle was displaced to the left.

After this procedure the papilledema began to advance; the margins of the disks became indistinct; the vessels became engorged and tortuous, and several hemorrhages made their appearance in both fundi. The elevation was measured at 2 diopters.

Ventriculograms taken on March 30, 1935, showed both ventricles well filled and shifted to the left (fig. 1). The anterior horn of the right lateral ventricle was displaced not only to the left but downward and posteriorly.

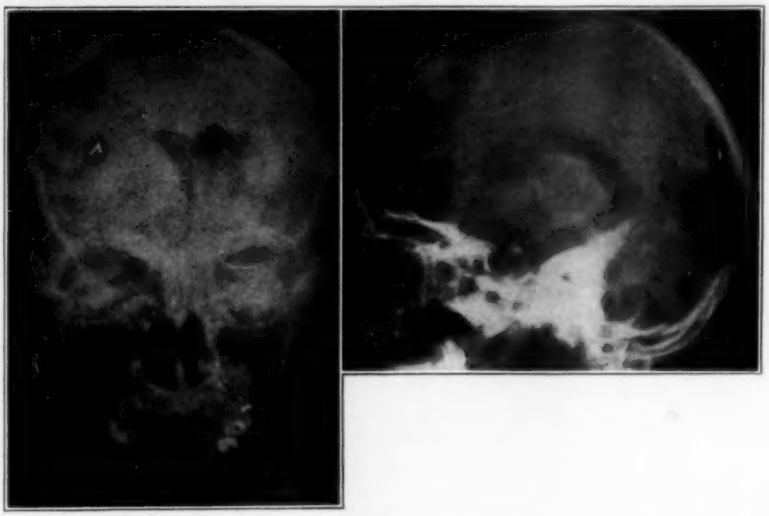

Fig. 1.—Ventriculograms showing displacement of the ventricles to the left and a defect in the right frontal horn.

Operation.—On April 1, 1935, operation was performed. Not being certain whether I was dealing with a cerebral neoplasm or with an abscess of the brain, I outlined a large right frontal flap and made a single trephination over the suspected site of the lesion. The exposed dura appeared normal in color but did not pulsate. An aspirating needle inserted to a depth of 4 cm. met a definite resisting membrane. When the needle penetrated this membrane, there was an immediate escape of thick yellow pus. The incision was enlarged; sufficient bone was removed to create a defect 4 by 3 cm., and the adjacent dura was thoroughly coagulated. Incision through the dura and the brain tissue was made with the Bovie scalpel; a long conical Mosher drain was inserted into the abscess cavity, and the wound was packed tightly. Culture of the pus obtained showed Staph. aureus.

Postoperative Course.—The patient promptly became free from headaches; the papilledema began to subside, and the pain behind the right eye disappeared.

On April 3, 1935, roentgenograms of the skull were taken to show the exact position of the Mosher drain (fig. 2). There was a moderate purulent discharge from the wound, and by the second postoperative week the drain began to pulsate.

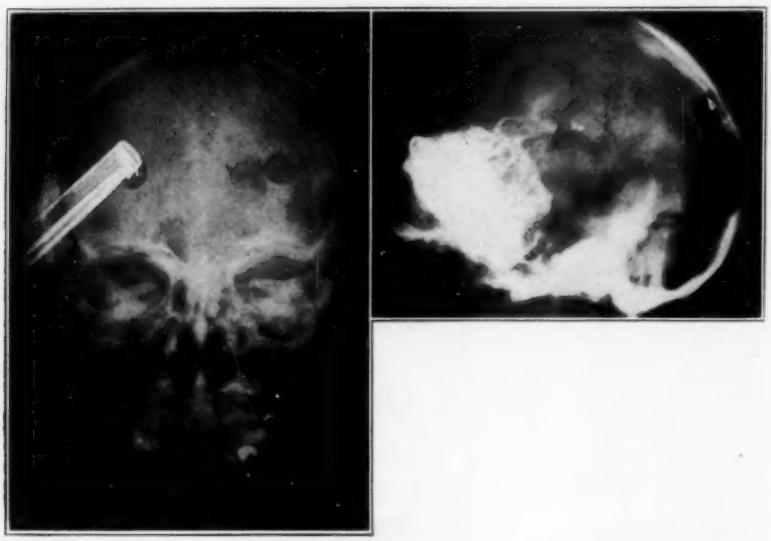

Fig. 2.—Roentgenograms showing a Mosher drain in the abscess cavity.

Fig. 3.—Mosher drain in the abscess cavity about to be extruded.

On April 24, 1935, a left facial weakness was noted, and at the same time there was an advance in papilledema. The Mosher basket was extruded on April 27, with little bleeding and no headache (fig. 3).

Because a moderate purulent discharge continued from the wound and because there was an associated cerebral hernia, aspiration was performed with a needle for a possible secondary abscess. None was found (fig. 4).

There was no headache, fever or disturbance of vision subsequent to the exploration. The general condition was excellent; the cerebral hernia, aided by several lumbar punctures, slowly retreated, so that by Aug. 1, 1935, the date of discharge, the wound was completely healed (fig. 5); the headaches were gone; the vision was 20/25 in the right eye and 20/30 in the left; the fundi were normal, and the remaining neurologic status showed no abnormal residual signs.

Fig. 4.—Cerebral hernia following reexploration for secondary abscess, with negative results.

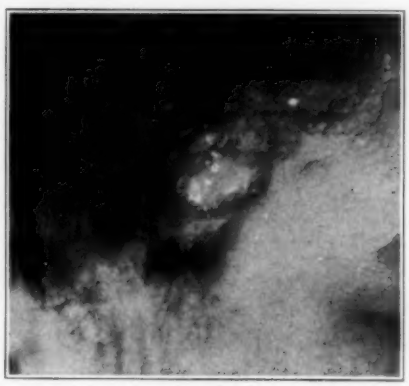

Fig. 5.—Operative site on discharge.

The patient has since returned to her usual occupation, and in a letter a year after operation she stated that she is "attending many social activities and all in all is feeling fine."

COMMENT

The diagnosis of a cerebral abscess secondary to disease of the sphenoid sinus is not easy. The symptoms presented by my patient were so few and equivocal that for some time there was considerable doubt as to the presence of an intracranial tumor. Ventriculograms proved beyond doubt that I was dealing with an expanding lesion in the

right frontal lobe. Whether it was neoplastic or suppurative could not be established with certainty until exploration was performed.

The early symptoms which may lead one to suspect a cerebral abscess complicating a purulent infection of the sphenoid sinus are in the main: (1) infection of the upper respiratory tract followed some time later by frontal headaches associated with intermittent pains in one eyeball and transient sensory disturbance of the trigeminal nerve on the same side, (2) headaches referred to the torcular, accompanied by some

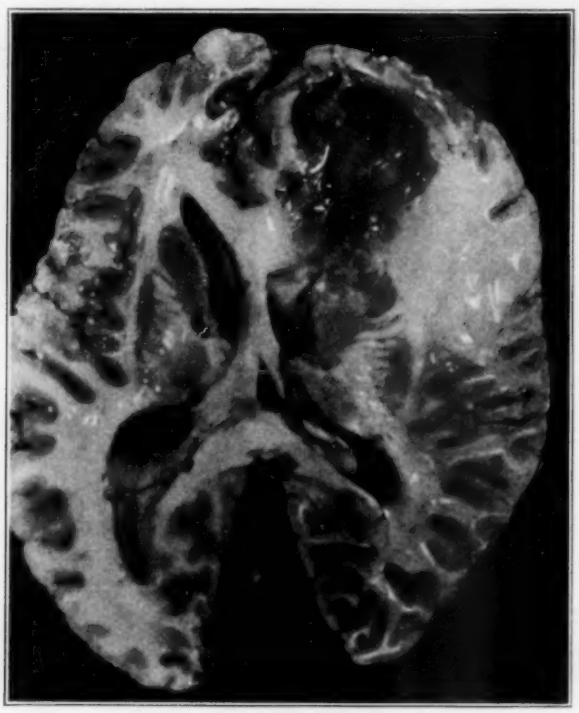

Fig. 6 (Dr. Druss' case).—Abscess of the frontal lobe.

stiffness of the neck, (3) early papilledema, particularly fulness and tortuosity of the retinal veins, (4) slight facial weakness on the contralateral side and (5) a generalized or focal convulsion.

INTRACRANIAL PATHWAYS OF INFECTION FROM THE SPHENOID SINUS

Druss [6] expressed the opinion that the pathway of infection from the sphenoid cavity into the cranium is most frequently direct as a result of necrosis of the bone. That infection may spread by way of the perforating blood vessels and lymphatic channels as well as through

osseous dehiscences is also accepted. In fact, this mode of spread is more likely in the acute fulminating sinus infection. It is significant, however, that the analysis by Turner and Reynolds [8] of 20 cases of intracranial complications following sinus disease revealed that in 85 per cent there was direct extension through the bone.

Fig. 7 (Dr. Druss' case).—Site of the perforation of the sphenoid sinus.

8. Turner, A. L., and Reynolds, F. E.: Study of Paths of Infection to Brain, Meninges, and Venous Blood Sinuses from Neighbouring Peripheral Foci of Inflammation: VII. Acute Suppuration in Accessory Sinuses; Cavernous Sinus Thrombosis; Acute Leptomeningitis; Death; Autopsy, with Microscopic Examination of Ethmoidal and Sphenoidal Air Sinuses and Cavernous Blood Sinuses, J. Laryng. & Otol. **43**:565 (Aug.) 1928.

The case reported in detail by Druss which was also reported by Kramer in a separate communication showed a perforation of the bony plate forming the roof of the sphenoid sinus. The purulent exudate spread from there to surround the pituitary gland and then over the orbital surfaces of the frontal lobes and cribriform plate, and in due course it became evident that in the gyrus rectus of the right frontal lobe there was a perforation which marked the entrance into a large well encapsulated abscess cavity, measuring 5 by 2.5 cm. (fig. 6).

Microscopic studies showed purulent exudate, with denuded mucous membrane, in a small cavity situated behind the right sphenoid sinus. The submucosa was infiltrated with cellular elements and contained granulation tissue which involved the bony tissue, particularly the roof of the sinus. It was at this point that perforation occurred (fig. 7).

The findings simulate most closely the pathway by which infection took place in my patient.

TREATMENT

Deductions as to treatment arrived at from a single instance can hardly be conclusive. However, the train of fortunate events as narrated in the case report serve to emphasize the factors brought out in a previous publication [9] on the treatment of abscess of the brain: (1) the initial and complete removal of the primary focus of infection, (2) the allowance of sufficient time for encapsulation of the cerebral abscess, (3) accurate visualization of the size, shape and location of the abscess, and (4) adequate and free drainage of the abscess after proper sealing off of the subarachnoid space to prevent meningitis.

SUMMARY

Recovery in a case of abscess of the frontal lobe secondary to empyema of the sphenoid sinus is reported.

Only 6 cases of this condition have been previously recorded. In 2 of these a cerebral abscess was suspected. None of the patients recovered.

Suggestions for criteria for early diagnosis of this condition are tabulated.

The probable pathway of infection from the sphenoid sinus into the cranial cavity is considered, and a similar case with the changes observed at autopsy is reviewed, with illustrations.

Some remarks are made about the treatment of this condition.

9. Kaplan, A.: Abscess of the Brain: Report of Five Consecutive Recoveries, with Special Reference to the Mosher Drain and Pneumographic Visualization of the Abscess Cavity, Arch. Otolaryng. **21**:385 (April) 1935.

EFFECTS ON THE THROAT AND CONJUNCTIVA OF THE HYGROSCOPIC AGENT USED IN CIGARETS

HOWARD C. BALLENGER, M.D.
AND
V. H. JOHNSON, B.S.
CHICAGO

Some work has been done on the composition of cigaret smoke and the effect of the various constituents of the smoke on the mucosa of the respiratory tract and on the conjunctival sac. Little investigation has been done on the possible irritative effects of the glycerin or diethylene glycol used as a moistener, or binder, in cigarets on the mucosa exposed to the smoke. Mulinos and Osborne [1] found the smoke from cigarets moistened with glycerin more irritating to the conjunctival sac of rabbits than that from those in which diethylene glycol was used, or from those in which no hygroscopic agent was employed. A mechanical smoker was used, in which the smoke was passed through water. Two or three drops of this water was instilled into the conjunctival sac of rabbits. The irritation was determined by the degree of edema produced. Flinn,[2] in a clinical investigation on human subjects, obtained similar results, as determined by the subjective and objective symptoms produced by smoking cigarets in which the two hygroscopic agents were used.

The products of the combustion of tobacco include carbon dioxide, carbon monoxide, nicotine, ammonia and aldehydes, such as acrolein, formaldehyde, furfural, tars and formic acid. It has not been definitely established which of these various products of combustion is the major factor in a possible irritation of the mucous membrane. However, it appears that acrolein, formaldehyde, formic acid and possibly furfural are the principal irritants. These products are present in all smouldering and burning vegetation. Certain factors enter into the rate of

---

From the Department of Otolaryngology of the Northwestern University Medical School.

This investigation has been made possible by a grant from the Glycerine and Soap Manufacturers Association.

1. Mulinos, M. G., and Osborne, R. L.: Pharmacology of Inflammation: III. Influence of Hygroscopic Agents on Irritation from Cigarette Smoke, Proc. Soc. Exper. Biol. & Med. **32**:241-245 (Oct.) 1934; Irritating Properties of Cigarette Smoke as Influenced by Hygroscopic Agents, New York State J. Med. **35**: 590-592 (June 1) 1935.

2. Flinn, F. B.: Some Clinical Observations on the Influence of Certain Hygroscopic Agents in Cigarettes, Laryngoscope **45**:149-154 (Feb.) 1935.

production of these possible irritants, such as the speed and manner of smoking. Fast smoking increases the carbon monoxide and nicotine content of the smoke and to a lesser extent the aldehyde content.[3] If the last third of the cigaret is smoked, the nicotine and probably the other harmful constituents of the smoke are greatly increased, which may or may not have an increased irritating effect on the mucosa. Ammonia is given off in the "side stream" but seems to be absent in the "main stream" of the smoke. Ammonia [4] and carbon monoxide [5] are probably not factors of great importance in irritating the respiratory mucous membrane. The conjunctiva may be irritated at times by the ammonia.

Glycerin as such is not irritating to the respiratory mucosa, as attested by its frequent use in medications for the nose and throat. There is experimental and clinical evidence that diethylene glycol is irritating to mucous membranes.[6] However, we are not considering glycerin and diethylene glycol exclusively but principally their combustion products, such as may be found in cigaret smoke. Of the numerous oxidation products of glycerin, only a few have had much study; these include glyceric acid, tartronic acid, mesoxalic acid and dihydroxyacetone. Acrolein is derived from glycerin and fats by the splitting off of water and is formed whenever fatty substances are heated to dryness and decomposed.[7] It is irritating to mucous membranes, with an action similar to that of formaldehyde but more severe.[6a] There is no evidence that acrolein is produced by the combustion of diethylene glycol. However, the slight addition or diminution of acrolein in cigaret smoke from the hygroscopic agent used in the cigaret would not seem to be a factor of great importance compared to the amount of acrolein and other irritants which would normally be present as a result of the combustion of the other ingredients of the cigaret.

---

3. Bogen, Emil: The Composition of Cigarets and Cigaret Smoke, J. A. M. A. **93**:1110-1114 (Oct. 12) 1929.

4. Dixon, W. E.: The Physiological Effects of Smoking, Practitioner **118**: 20-28 (Jan.) 1927; The Tobacco Habit, Brit. M. J. **2**:719-725 (Oct. 22) 1927; Lancet **2**:881-885 (Oct. 22) 1927.

5. Rolleston, Humphry: Medical Aspects of Tobacco, Lancet **1**:961-965 (May 22) 1926.

6. (*a*) Flury, F., and Wirth, W.: Zur Toxikologie der Lösungsmittel (Verschiedene Ester, Aceton, Methylalkohol), Arch. f. Gewerbepath. u. Gewerbehyg. **5**:1-90, 1933. (*b*) von Oettingen, W. F., and Jirouch, E. A.: Pharmacology of Ethylene Glycol and Some of Its Derivatives in Relation to Their Chemical Constitution and Physical Chemical Properties, J. Pharmacol. & Exper. Therap. **42**: 355-372, 1931. (*c*) Brekke, A.: Two Cases of Ethylene Glycol Poisoning, Chem. Abstr. **26**:1772, 1932. (*d*) Hanzlik, P. J., and Hunt, Reid: Toxicity of Ethylene and Propylene Glycol, Indust. & Engin. Chem. **24**:836-837 (July) 1932.

7. Hamilton, Alice: Industrial Toxicology, New York, Harper & Brothers, 1934, p. 201.

In an effort to determine as accurately as possible by clinical means any irritating properties of the hygroscopic agent used in cigarets, 130 subjects started smoking them under as carefully controlled conditions as possible. Of these, 100 completed the tests, and their reactions form the basis on which this report is made.

METHOD OF STUDY

The cigarets were identical in composition except in the hygroscopic agent used. One lot contained 2.61 per cent glycerin (table 1); the second lot contained 2.24 per cent diethylene glycol, and the third lot, which were the control cigarets, had no hygroscopic agent.

The subjects on whom these tests were made were largely medical students (85 per cent), with a few physicians, laboratory technicians and office assistants. None of the subjects or the investigators who conducted the experiment knew which lots contained the two hygroscopic agents until the conclusion of the tests. Each participant smoked exclusively the particular type of cigaret supplied for that week and no other form of tobacco. He smoked approximately the same number

TABLE 1.—*Analysis of the Hygroscopic Agents Used in Cigarets*

Hygroscopic Agent		Percentage
Glycerin	Moisture content	10.62
	Glycerin content	
	Moist sample	2.33
	Dry sample	2.61
Diethylene Glycol	Moisture content	10.21
	Diethylene glycol content	
	Moist sample	2.01
	Dry sample	2.24
None	Moisture content	7.33

of cigarets each week throughout the period of the tests. The average age was about 26 (25.85). Ninety-five men and 5 women participated. The average number of cigarets smoked per day was about 20 (20.46). The average number of years the participants had smoked was about seven and one-half (7.67) years.

Of the 100 participants who finished the tests, 62 were under observation for six weeks, smoking one of these three lots for one week and then changing to one of the other lots on succeeding weeks. Thirty-eight of the subjects were under observation for three weeks, alternating in the same way. As a supplementary test of the subjective symptoms and at the conclusion of the weekly tests just described, 41 smoked a combination of the three lots in any order they chose for one week. They then reported any subjective symptoms noted from each type.

OBSERVATIONS

At the time of the first examination, 66 of the 100 subjects reported various symptoms which they attributed to smoking. A dry or irritated throat was the most frequent complaint. This was mentioned in 48 instances. Varying degrees of cough, especially in the morning was the next most frequent complaint. This was listed 39 times. A husky or hoarse voice was complained of in 15 instances. A dry or irritated

nose was mentioned by only 8 of the subjects. Some of the participants listed only one region in which they thought smoking had an irritating effect. Others mentioned two or more. The subjects who stated that they had symptoms from smoking did not differ to any extent in their subsequent reports from those who stated that they had no symptoms from smoking.

Before the tests were started and at the conclusion of each week's smoking an examination of the nose, throat and conjunctiva was made and changes, if any, were noted. The subjective symptoms, if any were produced, were also noted.

The examinations of the nose, throat, and conjunctiva (table 2) before the tests were started revealed that 44 of the subjects had some degree of congestion and that 52 had an injected, congested or red mucous membrane of the nasal cavity. Thirty-seven had an injected or red conjunctiva.

TABLE 2.—*Results of Objective Examination of the Subjects Before and at the End of the Weekly Tests*

Before tests were begun	Nose congested	44
	Throat red or congested	52
	Conjunctiva red or injected	37
At end of tests with cigarets moistened with glycerin (2.61%)	Nose congested	36
	Throat red or congested	30
	Conjunctiva red or injected	38
At end of tests with cigarets in which no hygroscopic agent was used	Nose congested	60
	Throat red or congested	55
	Conjunctiva red or injected	45
At end of tests with cigarets moistened with diethylene glycol (2.24%)	Nose congested	43
	Throat red or congested	35
	Conjunctiva red or injected	39

The objective examination made at the end of the tests in which cigarets moistened with glycerin were smoked indicated some degree of congestion or redness of the nasal mucosa in 36 instances (table 2). The throat showed various degrees of congestion or redness in 30 cases, and the conjunctiva was affected in 38.

At the end of the tests in which cigarets with no moistener were used, the nose showed congestion or irritation in 60 instances; the throat was involved in 55 and the conjunctiva in 45.

At the conclusion of the tests in which cigarets moistened with diethylene glycol were used, the nose was involved in 43 cases, the throat in 35 and the conjunctiva in 39.

Complaints by the participants in the course of the tests of colds or sore throats which were evidently of an infectious nature would have an influence in both the subjective and the objective symptoms of irritation. In order to reduce this factor as much as possible and to average the changeable climatic or infectious periods, the cigarets were

rotated, so that at any time about the same number of each kind were being smoked by the various participants. These colds or sore throats that seemed to be of an infectious nature were noted and tabulated. Thirty-two were listed in the period when cigarets moistened with glycerin were used, 27 in the control period and 21 when the cigarets moistened with diethylene glycol were used. The objective findings (red throat, etc.) from any cause, whether infectious or not, were tabulated, as some difficulty might be encountered in trying to differentiate the possible inflammatory changes produced by smoking from those produced by infection or other causes.

From the objective examinations, evidence of inflammatory reactions seemed to be less for cigarets moistened with glycerin than for those moistened with diethylene glycol. The greatest number of inflammatory reactions were produced by the control cigarets in which no hygroscopic

TABLE 3.—*Reports of Subjective Irritation of the Throat as Given by the Participants at the End of Each Week's Tests*

Hygroscopic Agent	Irritations (Subjective)	At End of Weekly Tests	At End of Final Week with Combinations	Total
Glycerin (2.61%)	Least of all	29	9	38
	Less than controls	77	17	94
	Less than diethylene glycol	46	15	61
	Same as controls	26	7	33
	Same as diethylene glycol	40	8	48
None (Controls)	Least of all	17	11	28
	Less than diethylene glycol	45	12	57
	Less than glycerin	41	16	57
	Same as diethylene glycol	23	11	34
Diethylene Glycol (2.24%)	Least of all	42	10	52
	Less than glycerin	62	17	79
	Less than controls	82	17	99

agent was used. It is questionable how much reliance can be placed on these findings, as many factors other than the hygroscopic agent used in cigarets could enter in the production of these inflammatory reactions. These extraneous factors would be more evenly averaged as the number of subjects increased or as different groups were subjected to the tests.

The subjective symptoms referable to the mucous membrane from smoking are usually described as biting and irritation, burning, dryness, coughing, hoarseness and salivation. The subjective symptoms of the participants at the end of each week's smoking are shown in table 3. As may be observed from this table, the cigarets moistened with diethylene glycol were favored somewhat, with the cigarets moistened with glycerin next in favor. The control cigarets with no moistener seemed to be least popular. The 41 persons who smoked all three types for a week in any manner they chose reported the subjective symptoms about evenly divided between the three types. As in the case of the objective

examination, the findings in the subjective examination should not be considered as conclusive, especially in a group as closely associated as medical students, owing to the fact that some one advances the opinion that one of the brands is more irritating or less irritating than the others and the idea becomes contagious among others of the group. In fact, one student in reporting on his subjective symptoms asked if he should report what he thought or what "they all say." As a rule, although not invariably, the presence of a cold or sore throat seemed to influence the answers, as whatever cigaret was being smoked that week seemed more irritating.

CONCLUSION

From a clinical study of the personnel forming the basis of this investigation, it is concluded that the hygroscopic agent used in cigarets is not a factor of importance in producing symptoms or in producing objective evidence of irritation of the nasal or throat mucosa or of the conjunctival sac. In fact, the control cigarets, in which no hygroscopic agent was used, seemed to produce somewhat more irritation both objectively and subjectively than those to which glycerin or diethylene glycol was added.

Clinical Notes

TWICE A HOST TO A BRONCHIAL FOREIGN BODY

CHARLES PLUME SCHENCK, M.D., FORT WORTH, TEXAS

With most young children it is instinctive to make the mouth test on objects which come within reach. Considering the fact that the throat is the common gateway to the stomach and lungs and that everything which enters the former must pass over the larynx, it is remarkable that foreign bodies in the air passages are comparatively infrequent. Being host the second time to a foreign body in the lungs is an unusual and doubtful distinction, which has come to relatively few persons. This has already been the experience of a little girl, Norma A., born on Oct. 18, 1930, whose first accident occurred at 14 months and whose second accident took place a few weeks before her fifth birthday.

REPORT OF A CASE

First Admission.—The patient came from Burket, Texas, to the Methodist Hospital in Fort Worth, Texas, on Dec. 18, 1931, because it was suspected that there was a foreign body in the lungs. She choked about noon on December 16, and her mother thought that she might have inhaled the hand or foot of a little china doll.

The baby had an asthmatoid wheeze, audible across the room, which on auscultation was heard over the entire chest but best near the base of the right lung. Roentgen examination revealed a marked emphysema on the right side, with displacement of the diaphragm and mediastinum (fig. 1 *A*).

Bronchoscopic examination showed the right main bronchus to be obstructed by a white foreign body, which on removal proved to be the broken-off hand of a little china doll, measuring 10 by 6 mm. (fig. 2).

Auscultation the next morning showed the chest to be clear and the functioning of the lungs about equal. On roentgen examination the emphysema was shown to have almost disappeared (fig. 1 *B*). There was no elevation of temperature, and the patient was discharged on that date as cured.

Second Admission.—The patient again came under my care, this time from Big Spring, Texas, on Sept. 27, 1935, because of a suspicion of a foreign body in the lungs. Her mother reported that she "got black in the face" from a severe choking spell at lunch on September 26, while eating corn off the cob.

The patient was found to be playful and evidently not in much distress, if any. There was a slight elevation of temperature and a slight nonproductive cough. Physical examination showed the right side of the chest to be hyperresonant, with limitation of expansion and absence of breath sounds. Roentgen examination revealed a marked emphysema on the right side, with the heart and the mediastinum displaced to the left and the right side of the diaphragm depressed (fig. 3 *A*).

Read before the Eye, Ear, Nose and Throat group at the Sectional Meeting of the American College of Surgeons, Dallas, Texas, March 6, 1936.

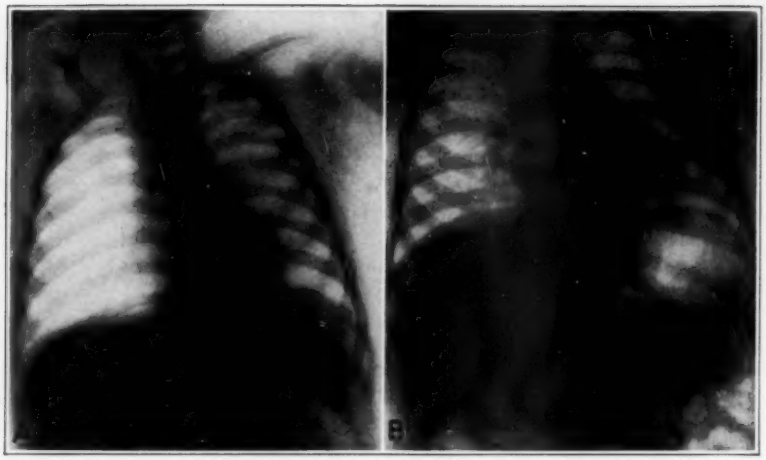

Fig. 1.—*A*, obstructive emphysema of the right lung before the removal of the china doll's hand from the right main bronchus. *B*, roentgenogram of the chest the day after the removal of the foreign body. The emphysema is almost gone.

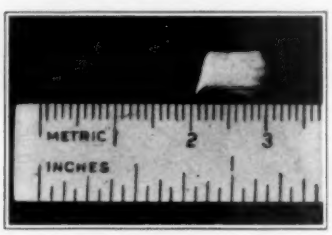

Fig. 2.—China doll's hand bronchoscopically removed from the right main bronchus of a baby 14 months old.

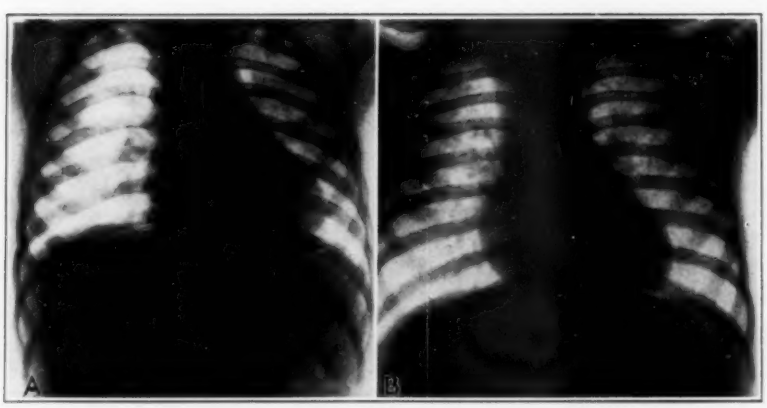

Fig. 3.—*A*, obstructive emphysema of the right lung before the removal of corn from the right main bronchus. *B*, roentgenogram of the chest the day after the removal of the corn. The emphysema is almost gone.

Bronchoscopic examination was performed about 5 p. m. on September 27 with the Jackson 5 mm. bronchoscope without anesthesia, and two large and three small pieces of a kernel of corn were removed from the right bronchus (fig. 4). Auscultation made shortly afterward showed practically normal breath sounds throughout the right lung.

On September 28 physical examination showed the right lung to be restored to full function and apparently normal. Roentgen examination showed that the heart, mediastinum and diaphragm were in normal position and that the emphysema was gone (fig. 3*B*). The recovery was prompt and complete to a spectacular degree.

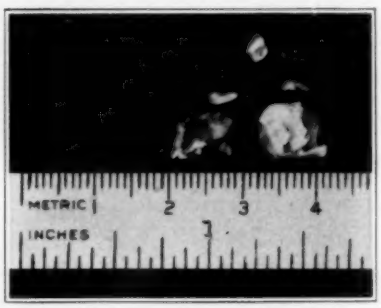

Fig. 4.—Fragments of corn removed from the right bronchus of a child 5 years old.

COMMENT

No laryngeal anomaly was present.

The history of a choking spell should never be ignored and may outweigh all other evidence obtained by physical and roentgen examination.

A false sense of security may be engendered by a symptomless interval following the accident.

After early diagnosis and skilful removal of a foreign body from the bronchus prompt recovery with no permanent damage should generally follow.

Postoperative physical examination and roentgen check of the lungs should always be made for obvious reasons.

No other instance has come to my attention of a child under 5 years of age having had two dissimilar foreign bodies bronchoscopically removed from the same site some years apart.

A SIMPLE TEST OF THE EXPLOSIBILITY OF THE ATMOSPHERE OVERLYING THE OPERATIVE FIELD WHERE DIATHERMY OR ACTUAL CAUTERY IS TO BE USED

PALUEL J. FLAGG, M.D., NEW YORK

Reports of fires and explosions when ether or some other anesthetic vapor is used in the presence of an electric cautery are not infrequent.

A positive test of the explosibility of the atmosphere at the point of contact at the time when the cautery is applied is much to be desired, not only from the point of view of safety but as medicolegal evidence in the event of accident.

A simple test to eliminate such danger may readily be performed as follows: An ordinary rubber syringe about 2 inches (5 cm.) in diameter into which the glass tip of an eye dropper has been inserted is sterilized with the surgical instruments to be used. An ordinary alcohol lamp is provided. The surgeon or his assistant expresses the air from the syringe and sucks into it the atmosphere of the operative field at the point at which the cautery is to be applied. The floating nurse then offers the lighted alcohol lamp to the assistant holding the syringe. The contents are blown directly into the flame. If there is no change in the color of the flame (fig. 1*A*), the field is absolutely safe for cauterization at that time.

When liquid ether is sucked into a syringe, if the excess ether is drained out and the vapor is blown into a flame, the mixture burns. It does not detonate. Figure 1 *B* shows the flame from the saturated ether vapor overlying liquid ether in a can. Such ether vapor burns with a yellow flame which does not backfire into the tube or syringe. An explosive mixture results when pure oxygen is mixed with ether vapor. In making this test the lighted alcohol lamp should be held above and removed from the operative field.

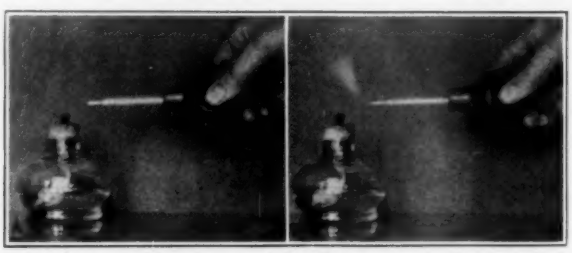

Fig. 1.—*A*, Ordinary atmospheric air blown into the flame produces no change in color. *B*, Air saturated with ether vapor blown into the flame burns with a yellow flame.

This test will be found a source of comfort and protection when diathermy is used in the pharyngeal airway, in cases in which for example anesthesia is induced by a mixture of gas, oxygen and ether and carried on by chloroform. It is also a valuable check in rectal work when an explosive anesthetic has been instilled into the rectum. The entire assembly is routine equipment in every operating room and becomes available on request.

40 East Sixty-First Street.

AN APPARATUS FOR DISPLACEMENT IRRIGATION OF NASAL SINUSES

RAPHAEL SCHILLINGER, M.D., BROOKLYN

The treatment of nasal sinusitis has been considerably enhanced by the introduction of displacement irrigation by Arthur W. Proetz, of St. Louis.[1] In like

1. Proetz, A. W.: The Displacement Method of Sinus Diagnosis and Treatment: A Practical Guide to the Use of Radiopaques in the Nasal Sinuses, St. Louis, Annals Publishing Co., 1931.

fashion, valuable diagnostic details have been made available by displacement filling of the sinuses with radiopaque fluids.

In performing displacement irrigation and filling by Proetz' technic, many operators employ a medicine dropper to introduce various solutions into the nose. The vacuum phase of the procedure is then carried out by applying the tip of a sinus suction bottle to the nostril, the bottle being connected to a suction pump or to some other device for producing negative pressure. The dropper and the suction tip are alternately applied to the nostrils until the procedure is completed.

This method for the introduction of fluid and suction has its drawbacks. The frequency of application and alternation of the dropper and the nasal tip

Fig. 1.—Retouched photograph of the apparatus

often becomes annoying to both the patient and the operator; the amount of fluid instilled is not always measured with ease, and there is an occasional accidental drip from the medicine dropper or suction tip into the patient's eye.

The apparatus described here has been designed to obviate these drawbacks and to make it possible to continue the application of medicament or opaque medium and suction in one nostril with but one insertion of the instrument and then to complete the irrigation or filling in the other nostril with the least amount of manipulation.

The apparatus consists of an upper bottle, for holding fluids to be instilled; a body, in which the suction and flow control valve is housed and which supports the tip of the suction tube and the nasal tip, and a lower bottle, for producing a vacuum and for the collection of recovered fluid and secretions. The upper bottle screws into the body of the apparatus and is graduated in 4 cc. units. Two

upper bottles are suggested, one of 20 cc. capacity, to hold opaque mediums, and the other of 32 cc. capacity, to hold fluids for irrigation. Two lower bottles are available, one to fit the holder of the suction gage stand and the other of flat-bottomed design to allow the operator to stand the apparatus wherever he may please. There are two sizes of nasal tip, one suitable for children and one for adults. They are removable from the stem for sterilization.

The flow and suction are controlled by a valve in the body of the apparatus. The valve may be worked from either side by either hand. In fact, the whole apparatus may be manipulated entirely with one hand, leaving the other free to regulate the position of the head and to occlude the opposite nostril. Turning the valve *FL* allows fluid to run into the nose through the tip; in this position the suction is automatically cut off. When the desired amount of fluid has entered the nose, the valve is turned to *SU*, thus terminating the flow of fluid and opening the suction line. Gentle fluctuation of suction, not exceeding 180 mm. of mercury, is made by thumbing the suction tube connecting tip which fits into the body of the apparatus. It is advisable to use a suction gage in order to avoid creating sufficient suction to withdraw the fluid which has been instilled. A reading of 7 on the gage, which is equivalent to 7 inches (17.7 cm.) of mercury, is the optimum amount of suction. The process of instillation and suction is repeated several times without removal of the apparatus from the nostril. When the treatment of one side is completed, the other side may be treated in like fashion. There is an advantage in recovering the secretions and other fluids in the lower bottle in that they are subject to inspection and may be collected for examination whenever desired.

Opaque mediums travel through the apparatus at various rates of speed, depending on the viscosity of the individual medium. The aqueous and emulsified opaque mediums have the same rate of flow as the aqueous solutions used for treatment. The opaque oil mediums should be diluted with light mineral oil and warmed to about 110 F., so that they may flow at a reasonably satisfactory rate.

The use of this apparatus enables the operator to perform displacement irrigations with dispatch and with the least amount of discomfort to both the patient and himself. An additional advantage is realized in the treatment of struggling children, because of the shortened time required for treatment and the minimized instrumentation.

This apparatus is manufactured by and may be obtained from the C. M. Sorensen Company, Long Island City, N. Y.

50 Plaza Street.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

---

FUNCTIONAL EXAMINATION OF HEARING

ROBERT SONNENSCHEIN, M.D.
AND
NORMAN LESHIN, M.D.
CHICAGO

During the past year much, if not preponderating, consideration has been given to the subject of audiometry and the question of aids to hearing. Especially does the German literature show a large number of papers on this subject. In view of the fact that Americans were in many ways the pioneers in the development of audiometers and in the study of audiometry, it seems strange that with the exception of men like Langenbeck most of the writers either pay scant attention to the American and English otologic literature or do not mention the American workers in this field at all.

Meissner [1] calls attention to the fact that it is often important to be able to determine the exact state of hearing in one ear with exclusion of the other. A number of methods of shutting out or "masking" the hearing in the nontested ear are mentioned, such as the Bárány noise apparatus, the Wagner shaking or friction method and various procedures, such as occlusion of the ear with the finger or various prostheses, with moistened cotton or with some other device. He also mentions the use of compressed air in the ear by Voss and the application of electrical noise mechanisms, such as those of Langenbeck and the Western Electric 3-A buzzer employed by Bunch. The noise apparatus employed by Meissner consists of a telephone receiver which has an olive-shaped tip for insertion into the external auditory canal, the tip itself being covered with thin rubber tubing to make it fit snugly.

Meissner with the oto-audion determined the hearing (as shown by graphs) in the well ear, leaving the deafened ear unoccluded. Then the deafened ear was occluded with a special noise apparatus and tones

---

1. Meissner, Hellmuth: Methods of Testing the Hearing in One Ear, Ztschr. f. Hals-, Nasen- u. Ohrenh. **39**:415, 1936.

of 100 decibel intensity used, and the curves for hearing for the well ear were again determined. He shows by several graphs, which are almost alike, that the ear which is being tested is hardly influenced by the ear in which the noise apparatus is placed. He emphasizes the fact that one can thus completely exclude one ear while testing the other and that the ear in which the noise apparatus is placed does not influence the hearing of the other ear. Meissner calls attention to the fact that his results agree well with those obtained by Bunch. The latter used a rubber cushion between the receiver and the head, but Meissner believes that his noise apparatus applied directly in the external auditory canal is even more serviceable.

Oesterle's [2] test for unmasking total unilateral deafness in malingerers is based on the fact that a person refers a sound to the ear in which the greater intensity of sound is used. This forms the basis for most tests of malingering. The apparatus consists of ear phones fitted over the head of the patient, with an electrical circuit in the apparatus enabling one to vary the intensity of the sound over a wide range. Numbers are spoken into a microphone in another room, and the patient is asked to repeat them. The sound at a low intensity is conducted first to the good ear and then suddenly is switched into both ear phones, with a much greater intensity in the deaf ear. The person simulating deafness, imagining that his deaf ear is being tested, states that he hears nothing at all. However, in genuinely unilateral deafness he would still repeat the numbers, for his good ear is receiving the same sound it had before the other ear was brought into the circuit.

Kafka [3] presents a modification of the stethoscope type of instrument used for transmitting sound to either or both ears. By interchanging the ear pieces, the malingering can be diagnosed. A number of these devices with various modifications have been presented in the literature within the last few years to test unilateral deafness in malingerers. Kafka cautions the otologist in presenting expert opinion in their cases. He suggests not only familiarity with various differential points but also the utilization of a carefully elicited history, laboratory studies, roentgen examination and a Wassermann test. A detailed illustration of his apparatus accompanies the article.

I. R. Ewing and E. W. G. Ewing [4] show the necessity for studying the audibility and intelligibility of speech in children for the proper

2. Oesterle, F.: An Improved Apparatus for Detecting Simulation of Unilateral Deafness, Ztschr. f. Laryng., Rhin., Otol. **36**:353, 1936.

3. Kafka, M. Martyn: A New Device for Testing Malingering in Unilateral Deafness, Laryngoscope **46**:383 (May) 1936.

4. Ewing, I. R., and Ewing, E. W. G.: The Use of Hearing Aids in the Treatment of Defects of Hearing in Children, J. Laryng. & Otol. **51**:213 (April) 1936.

treatment of their defects of hearing. The components of words must be examined on a physical basis to appreciate the practical value of imperfect hearing for speech. The most satisfactory point of reference for measuring the audibility of speech sounds has proved to be the level of intensity reached by the loudest vowel, which is the sound of "aw," as in "law"; "ah," as in "bark," is only slightly less loud. Under average conversational conditions at a distance of 4 feet (121.9 cm.) from the ear the level of intensity reached by the loudest vowel "aw" is approximately 60 decibels above the audible threshold. Fletcher and his workers found that even moderately loud conversational speech falls short of complete intelligibility in the technical sense. The consonants "th," "f," "v" and "z" tend to be imperfectly heard in quiet conversation. These investigations form an invaluable basis from which to investigate the extent and effects of partial deafness. This is especially valuable when the hearing aid apparatus is employed in educating children who have auditory defects.

At the Royal Schools for the Deaf, in Manchester, England, ear training is given by combining lip reading and hearing to the fullest possible extent. A suitable hearing aid apparatus is usually of considerable help. Experiments in the intelligibility of speech afforded conclusive evidence that many patients hear best with an aid capable of amplifying speech to high levels of intensity. Accurate reproduction of sound of high frequency is also necessary. The reproduction must be of high quality and should be used only by teachers trained in the technic required for this highly specialized form of work. The use of a hearing aid enables children to be taught to talk as far as possible with normal voices and correct pronunciation. Distortions introduced by an unsuitable hearing aid are reflected in the child's own speech. An apparatus which meets the proper requirements has been devised and is used satisfactorily in ten of the principal schools for the deaf in Great Britain. A series of tests with toys and objects has been devised in which the growing child learns to respond to certain sounds. These tests are invaluable in assessing the degree of hearing of the preschool age child. The use of a suitable hearing aid in the hands of an experienced teacher is invaluable for proper development of speech in the young child who does not talk and for correction in the care of the child with defective speech.

Hofsommer [5] shows in her survey of school children of Webster Groves, St. Louis County, Mo., that a majority of the children with impaired hearing had a low intelligence quotient. This is due mainly

5. Hofsommer, Aphrodite J.: Lip Reading and the Intelligence Quotient of the Hard of Hearing Child, J. A. M. A. **107**:648 (Aug. 29) 1936.

to a lack of educational experience and is not a result of deficient mentality. After from one to three years of lip reading given in the public schools 47 per cent of this group of children showed a definite increase in the intelligence quotient, and 78 per cent showed a definite improvement in classroom work. By contrast, in another group refusing instruction in lip reading, none showed an increase in the intelligence quotient and only 18.7 per cent made any classroom progress. These facts stress the importance of early diagnosis and the benefit of instruction as a part of the regular school curriculum. Early routine testing of children with impairment of hearing and complete examination for those showing definite loss of hearing, as was done with these children, followed by instruction in lip reading, will benefit the hard of hearing child immeasurably.

Schindler [6] calls attention to the fact that tactile sensation may lead to the erroneous interpretation of hearing tests on persons with high grade impairment of hearing or in deaf-mutes. The loud tones are felt but not heard by these persons. He cites the work of R. L. Wegel and his curve of tactile threshold in normally hearing ears.

Schindler examined many deaf-mutes by means of speech, Bezold tuning forks and the oto-audion and added to his examination the observation of the psychologic attitude of the patients during examination and the opinion of the teachers, relatives and classmates as well as testing the reaction of the vestibular apparatus.

Only persons with insignificant "rests" of hearing or those absolutely deaf were tested. The tactile sensation was demonstrated in the patient by holding the telephone receiver at first not against the ear but against the ball of the thumb or some other part of the body. When the intensity of sounds used is increased to a certain point, one reaches a sound tactile threshold at which there is at first a tickling and then a painful sensation.

The author asks how far a knowledge of the tactile threshold influences the utilization of "rests" of hearing. Then he answers this by saying that only those deaf-mutes should be excluded from instruction in hearing in whom the tactile threshold is high.

One need not expend his greatest efforts on those children whose hearing curves present theoretically only slight chances for the development of a proper use of the organ of hearing. On the other hand, in many deaf-mutes who present more extensive hearing "rests," it would be possible to obtain desirable results with exercises and practice.

Steinberg [7] stresses the fact that with the great amount of automobile traffic now prevalent attention has been called in the literature to the

6. Schindler, Benno: Tactile Sensation of Deaf-Mutes and Its Practical Significance, Ztschr. f. Hals-, Nasen- u. Ohrenh. **39**:431, 1936.

7. Steinberg, Gerhardt: Oto-Audion Examinations of Hard of Hearing Truck Drivers, Ztschr. f. Hals-, Nasen- u. Ohrenh. **39**:442, 1936.

importance of the hearing of truck drivers. In order that signals and horns may be heard by the drivers, it is important that examinations be made to determine their hearing ability. The author states that the hearing for ordinary speech is not an absolute criterion of hearing ability, especially with reference to sounds of signals and warning noises. He quotes opinions to the effect that many of the horns are of a pitch from 290 to 300 vibrations but that they may have overtones as high as 4,000 vibrations. Steinberg concludes that for truck drivers hearing below 250 vibrations is not important.

Steinberg's procedure is as follows: After the usual tests of hearing, with whisper and conversational tone as well as with tuning forks, examination with the oto-audion is carried out. Then a ride is taken in an open truck with the person making the examination sitting next to the driver, who indicates with the hand whether the various sounds, like those of automobile horns, noises of street cars and that of other automobiles and trucks, are heard. Then the same procedure is carried out artificially, the patient being made hard of hearing by closure of the meatus or other means, and the results are compared. After the ride further examination with the oto-audion is made. The curves for both ears are combined, so that graphs show the binaural hearing curve. The author states that these test rides have demonstrated that one may consider the hearing ability sufficient if the driver can hear 70 per cent of all the noises and signals present in the street traffic.

Lindsay and Perlman [8] in a group of twenty-five patients with Paget's disease found that seven had involvement of the skull. Of these, four presented definite impairment of hearing. The common characteristic of this deafness is impairment of the inner ear or the auditory nerve. Two patients also had marked impairment of conduction. One had conduction deafness in one ear during one stage of the disease. Their findings correspond fairly well with those previously reported in the literature. The clinical characteristics offer little evidence of a relationship between Paget's disease and otosclerosis.

Lindsay, Kobrak and Perlman [9] were able to make determinations of the threshold for the sensation of hearing by observing the stapedius reflex in response to sound. Twenty-five persons were observed, and in many cases thresholds for both air conduction and bone conduction were determined. They found a close parallelism between the sensation of hearing and the reflex. From their observations they feel that the stapedius reflex is an integral part of the human ear, comparable to

8. Lindsay, J. R., and Perlman, H. B.: Paget's Disease and Deafness, Arch. Otolaryng. **23**:580 (May) 1936.

9. Lindsay, I. R.; Kobrak, H., and Perlman, H. B.: The Stapedius Reflex to Hearing Sensation in Man, Arch. Otolaryng. **23**:671 (June) 1936.

the light reflex of the pupils. The importance of this reflex for practical clinical purposes at present is limited. It can be used to determine the presence of hearing in persons suspected of malingering or in children. Its chief value is as an indicator of hearing for otologic investigations in animals. Certain conditions are necessary for the observation of this reflex. The stapes or the stapedius tendon must be visible and the mobility unimpaired by adhesions or any other pathologic condition. It cannot be seen through the normal drum. The hearing function must be satisfactory, and the reflex arc must be intact.

Wolfgang Schwarz [10] states that already in 1919 certain requisites for an ideal source of tones for otologic purposes were recognized. The apparatus should produce all audible tones from the lowest to the highest pitches in continuous series and free from overtones. The production of each tone must result instantaneously, and each tone in its intensity must be possible of variation at will from the point of sensation of pain down to the threshold of hearing. The apparatus must be free from all delays in transmission and capable of being connected directly to the lighting current. Furthermore, one of the principal requisites is that the graphs of hearing must be independent of the place of examination and of the appliance used, so that all graphs may be comparable one with the other. Lastly, the price should be so moderate that every otologist will be able to purchase the appliance.

The author gives a detailed account of his investigations and lists the various speech areas, such as that of Bezold, b-1 to g-2, about 450 to 8,000 double vibrations, that of Stumpf e-2 to c-3, 650 to 1,000 double vibrations, and that of Ulfilas Meyer, 500 to 2,100 double vibrations. He also considers the subject of the production of graphs and their evaluation, mixed tones and the effect of resonance together with many graphs illustrating the various points emphasized.

Schwarz calls attention to the fact that the Stenger test for the uncovering of simulation of unilateral deafness may be well carried out by means of an audiometer and states that the original suggestion for employing the oto-audion for this purpose came from Frenzel and Hinsberg. The procedure seems to be considerably more complicated than that usually carried out in the classic manner by means of tuning forks in accordance with the original method of Stenger.

The author in his conclusions, which are brief, states that to answer the question whether the functional examination of ears with the oto-audion can supplant that carried out with a continuous series of tuning forks, admits that he is not a physician and therefore cannot judge this

10. Schwarz, Wolfgang: Can the Fundamental Examination of the Ear with the Oto-Audion Supplant the Examination with a Continuous Tuning Fork Series? Ztschr. f. Hals-, Nasen- u. Ohrenh. **38**:248, 1936.

question from the medical standpoint. However, since audiometry during the past few years has been introduced more and more into medical practice, Schwarz considered it necessary to demonstrate that the objections which had previously been raised against the oto-audion have been satisfactorily answered. In a word, while he does not say definitely that the oto-audion and other audiometers should take the place of tuning forks, he believes that all the tests may be made satisfactorily and certainly as accurately as with tuning forks.

It is surprising in view of the great amount of work the author has done that no references from the literature are given, and it is surprising also that other German authors quote the American literature so sparingly. When one considers the enormous amount of pioneering and fundamental work that was done in this country in developing audiometers, it is a sad reflection on the industry of some of the foreign writers in consulting the literature, or it shows lack of proper appreciation of American workers, as well as injustice in failing to give the references to the American literature.

Kluge and Reisig [11] have studied in considerable detail the functional testing of hearing with tuning forks and audiometers. They stress the great contribution of Frederich Bezold in the development of the principles and methods of the functional testing of hearing and emphasize the fact that to the present day he serves as the highest authority. The strong influence of a great tradition must be broken before new methods can completely displace his work in otology.

The authors ask the question: "Where should the audiometer supplant the tuning forks?" They offer as an answer that they agree essentially with the view of Langenbeck, who stated that the practicing physician whose purpose is mere diagnosis and who has been able to effect this purpose with three or four tuning forks should retain this simple instrumentarium for qualitative purposes. The specialist, however, particularly the one who must give expert opinions, especially in medicolegal work and who has previously used a large series of forks, should either employ the audiometer in their stead or use it to supplement his work. For the larger clinics and especially for all institutes of otologic research it seems indispensable to have an accurate reliable electrical device for testing the function of hearing. The authors contend that from the physical standpoint the audiometer and tuning forks are of equal value for qualitative testing of hearing but that for quantitative estimation an accurately calibrated audiometer is superior.

One of us (R. S.) has repeatedly called attention to the fact that if forks are supplied with the "constant" of damping, it is possible to

11. Kluge, M., and Reisig, G.: Physical Principles of the Functional Testing of Hearing with Tuning Forks and Audiometers, Ztschr. f. Hals-, Nasen- u. Ohrenh. **38**:226, 1935.

get the same data as with audiometers, but if many pitches are tested, it requires more time for the examination.

Knudsen and Jones[12] emphasize the fact that the development of the thermionic vacuum tube, which reached its practical stage in 1913, has been a great factor in the development of pure and applied acoustics. Audiometry was one of the developments of the research which ensued, and it furnished a most important factor in the study of impairment and loss of hearing.

Some years ago the writers concluded that more precise methods of study were needed both for diagnosis and for the prescription of aids to hearing. Some of these requirements were (1) the determination of the degree to which a patient could hear the amplified conversational voice and the amplified whisper, both by air conduction and by bone conduction, (2) the presence of a source of tone covering the frequencies from 135 double vibrations to the upper range of hearing and (3) the fact that the test range should be pure and free from all higher harmonics. Also, that such tests should be made in a quiet environment and that a noise apparatus should be used to mask the sound in one ear while testing the other. The authors also emphasize the fact that bone conduction should not be measured at a single frequency, such as 128 or 256 double vibrations, but should be carried out along a wide range of frequencies. They state that it is for frequencies of about 2,000 cycles that measurements of bone conduction are particularly significant, for two reasons: 1. Bone conduction tests are used for detecting impairment in the cochlea or in the perception apparatus. 2. In such lesions the acuity of hearing is usually impaired for frequencies above 2,000 cycles, and for frequencies above this the acuity of hearing by bone conduction is almost entirely independent of the condition of the external and the middle ear; whereas in frequencies below 2,000 cycles the acuity by bone conduction is greatly influenced by lesions of the external or the middle ear. Emphasis is also laid on the fact that precise audiometry is possible only in a quiet room. If noise of any kind could be heard by the patient, it would produce a masking effect on the test tones. The authors state that hearing tests conducted in a noisy room fail to detect the impairment in all those for whom there is hope of arresting the progress of the deafness before it has become a serious handicap. It is necessary, therefore, that rooms free from noise or sound-proof booths be used for all tests of hearing.

With these points in mind, Jones and Knudsen twelve years ago designed an instrument which met the two prime requirements—diagnosis

12. Jones, I. H., and Knudsen, V. O.: Audiometry and the Prescribing of Hearing Aids, Laryngoscope **46**:523 (July) 1936.

and the prescribing of hearing aids. The particular feature of this instrument was the provision for amplification of the conversational voice and whisper. Vacuum tubes which were used for the amplification were also used as oscillators for the production of tones. The instrument was designed for selected amplification of the conversational voice, so that amplification could be given to high tones or low tones; it had a special telephone receiver for testing bone conduction from the lowest frequencies up to 4,000 cycles and a special noise apparatus. A number of these instruments were made and used at various universities, hospitals and private offices. As a result of this experience, a new type of instrument was further developed. This apparatus operates from house current, either alternating or direct, in place of batteries. The oscillators provide pure tones, octaves from 128 to 8,192 double vibrations and also a continuous sweep of frequencies from 2,500 cycles up to and beyond the range of hearing. This instrument also has a new bone conduction receiver, which is not influenced by the degree of pressure with which it is pressed against the head and is protected by a rubber flange which excludes hearing by air conduction. As a special amplifier the instrument constitutes in itself a hearing aid. All possible variations of amplifications of conversation and whisper can be tested by both air and bone conduction, and the otologist therefore knows at once: (1) whether the patient hears well with the hearing aid, (2) whether he hears better by air or bone conduction and (3) the degree of amplification by which he hears best.

With reference to hearing aids the authors state that in general the appliances which show the least amplification are those produced as long as fifteen years ago, whereas those which show the greatest amplification are the most recent instruments.

Recent tests have shown that persons with as little as 50 per cent of normal hearing can hear almost perfectly by amplification of frequencies up to 8,000 cycles. In many instances, to obtain sufficient amplification rather bulky apparatus which was not portable resulted. The authors feel that one should not expect too much from selected amplification, for the ear is so constructed that it can tolerate a considerable amount of distortion and yet understand speech well. It seems definite that considerable work must still be done in improving hearing aids, so that they may meet the requirements for each person. In a word, efforts should be made to provide hearing aids which will give the greatest amplification at those pitches at which the hearing of the patient is most efficient.

Mr. Watson and Mr. Sepmeyer, who are associated with Jones and Knudsen, are now doing special investigative work to determine the usefulness of the audiometer in the prescribing of hearing aids and are carrying on studies on selective amplification.

In a veritable monograph on the subject of electrical acoustic appliances and aids to hearing Bernhard Langenbeck [13] considers the subject with great detail. The article is divided into several parts, the first dealing with the methods employed in audiometry. The author states that since Bezold's time functional tests have been carried out by means of pure tones; formerly the tones were produced by means of tuning forks, but now with the audiometer pure tones throughout a long range of pitches are easily produced. He states that functional testing with tuning forks has certain disadvantages, especially in attempting to make quantitative tests. Qualitative estimations are easily arrived at with the tuning forks, but for quantitative estimations he believes that audiometers only should be used.

Furthermore, he points out that the audiometer may be used just as well as forks for the determination of involvement of the conduction apparatus, impairment of the perception apparatus or a combination of the two. He devotes some paragraphs to the description of the units employed in audiometry, especially the decibel, and the methods of obtaining graphs, which are now employed to such a great extent. He claims, in common with Shambaugh and others, that when the usual telephone receiver is used there is some conduction by bone as well as by air. This subject has been a matter of great dispute. Electrical engineers hold that with a telephone receiver held against the ear sound is conducted only by air. Bunch suggested some years ago that a pad of soft rubber placed between the receiver ... the head would eliminate any possibility of transmission by bone conduction.

Langenbeck emphasizes the fact that with the audiometer it is possible to determine the beginning of involvement of the auditory nerve, with diminution in hearing for the high tones, especially in the range c-5 (4,096 double vibrations) and c-6 (8,192 double vibrations). He seems inclined to think that this can be done better with the audiometer than with the c-5 tuning fork or the c-6 sounding rod. One of us (R. S.) believes, however, that with the tuning forks and especially with the c-5 or c-6 sounding rod it is easy to note early change in the hearing for these pitches, and this always makes one suspicious of a beginning change in the auditory nerve.

Langenbeck also calls attention to the fact that in medicolegal work audiometry is of considerable importance, since the audiograms furnish definite evidence of changes in hearing. These curves, of course, may also be obtained by the use of forks calibrated with a constant of decrement, but when a number of pitches are employed it requires more

13. Langenbeck, Bernhard: Electro-Acoustic Testing Appliances and Hearing Aids, Ztschr. f. Hals-, Nasen- u. Ohrenh. **39**:201, 1936.

time. For the unmasking of simulation of unilateral total deafness the same principles employed in the Stenger test may be carried out with the audiometer.

Langenbeck also discusses other phases of testing with the audiometer, such as the investigation of deaf-mutism and symmetrical hereditary deafness. In a rather brief section at the end of his article he discusses the subject of microphone electric hearing aids. He emphasizes the importance of careful examination of the appliances with reference to each particular patient in order that the greatest advantage may result for the individual. He states that when there is only slight loss of hearing these electrical aids are as a rule of no assistance; in fact, at times they interfere somewhat with hearing. One must not be deceived by the fact that the patient may often by means of the hearing aid understand at a greater distance and then suddenly experience great difficulty when the distances are changed. Often numbers are well understood at room length whereas ordinary conversation can be appreciated only at a much shorter distance. The development of the bone conduction attachment has been of great service in cases in which bone conduction was fairly normal or relatively lengthened. The author believes that all in all the results with the ordinary microphone-telephone hearing aids have been rather modest. He feels that one must be fairly well satisfied if a person with marked impairment of hearing can be improved sufficiently to get about in his work and in his social intercourse without too much difficulty.

Langenbeck's article does not easily lend itself to abstracting, for it is replete with details, but its careful perusal will compensate any one who is interested in the subject. He has a comprehensive grasp of the subject and of the literature. This article is outstanding also in that it cites an extensive bibliography, not only European but American, so that all phases of the subject are well covered.

Steinberg [14] calls attention to the fact that Schwarz in 1934 and 1935 presented facts regarding his S-audiometer. This apparatus was said to have the great advantage of low price and absence of resonance. With this apparatus Schwarz produced tones by means of so-called "impulse stimulus" (*Stosserregung*). Impulse stimulus is designated as an automatic onset and cessation of high-pitched tones in a tube, as high as 20,000 per second. The author shows the oscillograph of pure sinus curves of pure tones, but those derived from the S-audiometer show great irregularity. In a word, Steinberg claims that the tones derived from the S-audiometer are decidedly impure. Furthermore, a marked humming adventitious sound is obtained when using the S-audi-

14. Steinberg, Gerhard: Examinations or Investigations of the S-Audiometer, Ztschr. f. Hals-, Nasen- u. Ohrenh. **39**:557, 1936.

ometer. Schwarz concludes that the expectations regarding the qualities of the S-audiometer have not been realized. Furthermore, the problem of constructing a good and at the same time cheap audiometer has not been solved in Germany.

Martin [15] describes briefly the various types of hearing aids. He deprecates the fact that aids costing little have been sold at excessive prices and foisted on the public without being tested for efficiency and without consideration for the individual person. One should determine which persons are best suited for hearing aids. The otologist should be equipped properly for testing electrical hearing aids, so that he can properly prescribe for his deafened patient. The otologist should also educate the general public in its attitude toward the user of a hearing aid.

Tumarkin [16] emphasizes the necessity for an accurate refraction of the patient's hearing power and the prescription of an instrument designed to compensate accurately for this loss in order to provide a satisfactory electrical aid for a given patient. This can be accomplished only by scientific audiometry and selective amplification. There are six factors which explain the relative failure of the hearing aid up to this time. First, there is the inadequate range, from 120 to about 8,000 double vibrations. Normal hearing extends from 16 double vibrations to about 20,000. A limiting of the low range merely alters the timbre of the spoken voice. However, lowering the upper range rapidly impairs intelligibility. Second, the energy distribution of speech varies with the pitch and is found mainly in the lower pitches. The ear also varies in sensitivity to pitches. Higher notes must be produced with more energy than lower ones to be perceived by the ear. These three points all bear out the fact that the patient can less afford to lose his hearing for the high tones than for tones of the lower range. The fourth factor is masking. Given a mixture of high and low tones, intensifying the low tones will mask the high ones, but the converse does not occur. When all tones are amplified, the low tones still mask the amplified high ones. There are also definite mechanical limitations of the older instruments. The commercial carbon microphone does not react to high tones, and produces hissings and cracklings due to its own imperfections located in the high frequency end. The dry cell used to produce the power and the telephone receiver are also unsatisfactory. Finally, the patient's own receiving apparatus, owing to distortions, defects and adhesions of the conduction apparatus, will respond excessively at one portion of the scale while failing to react to others.

---

15. Martin, G. E.: Hearing Aids, Brit. M. J. **2**:173 (July 25) 1936.

16. Tumarkin, A.: Scientific Audiometry and Selective Amplification in the Design and Construction of Modern Deaf Aids, J. Laryng. & Otol. **50**:838 (Nov.) 1935.

Scientific audiometry plays an important essential part. The ordinary audiometric curve, especially for air conduction, gives only the threshold of hearing and does not disclose the physical strength of various sounds that are being tested. Sound is a form of energy and so can be measured in units of power as microwatts. This could be measured at the threshold of hearing and a graph plotted on the basis of the power required to make these various tones audible. The other failing of the ordinary audiogram is its limited range of testing. Usually only eight frequencies are tested; the ear can distinguish at least 2,000 different notes. It is more than likely that peaks and valleys corresponding to regions of resonance and damping may be present. This could be obviated by using a continuous band audiometer.

Having this information, the aurist can prescribe an accurate hearing aid. Can the manufacturer produce such a special instrument? At present he cannot, but selective amplification is being gradually developed. If the patient were not so self-conscious as to require an inconspicuous device, greater and faster progress could be made along these lines. The deafened person requires special and careful tests to classify his condition properly, so as to give him the full advantage of the advances of modern science.

Morris[17] presents a detailed description of electrical hearing aids, which he divides into three groups—individual, semiportable and group aids. He describes the mechanical construction of these devices and explains some of the mechanical disadvantages. Although a large number of these aids are in use, none has been tested to pass a universally recognized standard. Undoubtedly, manufacturers do submit their apparatus to some form of test before acceptance, but there is no uniformity among standards of testing. A special laboratory and apparatus should be maintained for the calibration of the test microphones, artificial ears and other devices, and a routine method of testing should be decided on. Morris describes the photo-electric talking machine for producing standard speech. The output from such a device could be arranged to be constant under all conditions. Records of speech and frequency could be fitted as required. An extensive bibliography on the subject of electrical hearing aids as well as on the subject of measurement of hearing and the standardization of apparatus and general information, with a list of patents, accompanies this presentation.

Hartig and Newhart[18] investigated the performance characteristics of electrical hearing aids for the deaf. This study was made possible by funds supplied by the Graduate School Research Committee of the

17. Morris, I.: Characteristics and Properties of Electrical Deaf Aids, J. Laryng. & Otol. **50**:809 (Nov.) 1935.

18. Hartig, Henry E., and Newhart, Horace: Performance Characteristic of Electrical Hearing Aids for the Deaf, Arch. Otolaryng. **23**:617 (June) 1936.

University of Minnesota and was begun in July 1934. An extensive series of tests was conducted on the latest products of four leading manufacturers. The common feeling or belief that the amount of amplification supplied for every frequency interval should be fixed to restore the patient's threshold of hearing to normal throughout the audible range is not necessarily so. What a patient may need is simply an amplification for faint sounds and not for ordinary conversation. The amplification should be varied not with frequency but with loudness, after the manner of the automatic volume control on the modern radio set. Only a small part of the listening a normal person is called on to do is carried on at the threshold of hearing. This should serve as a caution in accepting a theory which places the whole responsibility for loss of hearing on displacement of the threshold of hearing. Before an intelligent prescription for amplification of sound can be made for a person with impaired hearing, one must determine not only the intensities of sound at the threshold of hearing but also the equal loudness contours extending from the threshold of hearing to the loudest tolerable sound levels. The difficulties of obtaining such contours are considerable. If this is to be carried out, the ideal of prescribing a hearing aid as one does glasses will prove to be a matter of considerable difficulty to put into practice. At the present time no rational program of prescribing amplification can be presented owing to a lack of sufficient fundamental knowledge of defective hearing. In addition, in their present mechanical state electrical hearing aids could not fulfil properly the necessary amplification prescribed. This could be overcome to some extent if such limitations as weight, bulk and cost of the instrument were removed. The minimum requirements for electrical aids in view of their present mechanical structure should be sufficient amplification of sound free from sharp peaks for a response covering a minimum frequency range of from 200 to 3,000 cycles, freedom from internal and nonlinear distortion noises and freedom from erratic noises.

The hearing aids were tested basically on their ability to transmit speech sounds and sentences and on the presence or absence of the defect just mentioned. Hartig and Newhart found important differences in the amount of amplification produced and great differences in the intelligibility ratings among the various hearing aids of different manufacturers employing a carbon microphone, a carbon amplifier and an ear-fitting receiver. Those aids having a low intelligibility rating were also found to have the greatest volume of noise by-products due to nonlinear distortion. This may be the cause of the poor intelligibility. The portable hearing aids of the present design are largely ineffective because of insufficient amplification. The best means of determining the personal usefulness of a carbon microphone hearing aid of known merit is the discrete sentence intelligibility test. The tests made with

bone conduction oscillators indicated that the relative merit is not affected by the substitution of bone conduction for air conduction when tried on persons with normal bone conduction.

Hartig and Newhart suggest a simple test for eliminating the most inefficient commercial aids from consideration. An exponential horn is used which has an opening of 22 inches (55.8 cm.) with a tapered fitting so as to match the holes of the receivers of the hearing aid. A speaker talking into the microphone of the hearing aid is in one room, while a number of observers are in an adjoining room. Tests of intelligibility of sentences and of articulation of syllables are performed. Although the horn itself may produce distortion and no numerical measurement of the amplification is obtained, this test permits hearing aids of different performance characteristics to be differentiated. When they differ greatly, the poorer ones can be readily eliminated by this means.

Abstracts from Current Literature

Ear

MORPHOLOGICAL AND FUNCTIONAL DEVELOPMENT OF THE MEMBRANOUS LABYRINTH IN THE OPOSSUM. O. LARSELL, E. MCCRADY JR. and A. A. ZIMMERMANN, J. Comp. Neurol. **63**:95 (Dec.) 1935.

The vestibular mechanism of the opossum does not begin to function until forty-one days after birth, yet at birth the animal displays independent migration to its mother's pouch. Negative geotropism is the guiding factor in this act. In this study the embryologic development and histogenesis of the membranous labyrinth and its nerves are traced from the earliest embryologic primordia through the entire period of occupation of the pouch. The animal is born late in the thirteenth day of fetal life and remains in the pouch for about fifty days.

Sixty-three series of sections of embryos from the eight somite (medullary plate) stage to birth and sections of the heads of young opossums of nine sizes from the pouch were studied. From twenty-nine days after birth onward, a series of tests for vestibular reflexes were performed, and one specimen of each stage was treated with a modification of Ramón y Cajal's reduced silver method to stain nerve endings in the membranous labyrinth. Auditory tests were also made. In the early part of the ninth day of development the otic placode and the anlage of the acousticofacial ganglionic complex are recognized. By the middle of the ninth day the otic placode has become a deep cup. The endolymphatic duct is seen during the later part of the tenth day. Nerve terminations were seen in relation to both vestibular and cochlear hair cells long before there was any indication of functional response to stimuli by either the vestibular or the cochlear apparatus.

Acoustic reflexes appeared at fifty days after birth, first to high, shrill notes and on subsequent days to successively lower notes in the musical scale. The differentiation of the organ of Corti was from the basal coil toward the helicotrema. The authors suggest that the development of myelin on the preexistent nerve fibers may be a result of the activity of these fibers induced by the capacity of the end-organ to produce a nerve impulse.

ADDISON, Philadelphia. [ARCH. NEUROL. & PSYCHIAT.]

OUR DEAFENED CHILDREN AND HOW WE ARE CARING FOR THEM. GORDON BERRY, Rhode Island M. J. **18**:182 (Dec.) 1935.

The care of deafened children, including national activities, the progress in Rhode Island and the history of the developments in this field, is briefly reviewed. A strong appeal is made to members of the medical profession to use their influence in encouraging schools and other agencies to advance the care of these handicapped children.

The program for the schools consists in testing all the children with the 4-A audiometer, having an otologist examine those whose hearing seems to be below par and referring the truly deafened for further otologic treatment. The deafened child should be seated where he can hear and see best, and classes in lip-reading should be established. BUFFUM, Providence, R. I. [AM. J. DIS. CHILD.]

NONSUPPURATIVE OTOGENOUS ENCEPHALITIS OF THE TEMPORAL REGION. J. A. BIJLEVELD, Rev. d'oto-neuro-opht. **14**:81 (Feb.) 1936.

Nonsuppurative otogenous encephalitis is almost always diffuse. It is characterized by continuous high fever without slowing of the pulse and by headache, which is less characteristic than that of cerebral abscess. Bijleveld reports the

case of a child aged 5 years in whom the symptoms were different from those in the classic form of the disease. After bilateral mastoidectomy the fever was of the pyemic type; the pulse was very rapid; cultures of the blood were sterile; a meningeal reaction was not present, and there were marked focal signs (mimic facial paralysis on the left side). The right temporal lobe was explored with negative results so far as the presence of pus was concerned, but softened cerebral tissue was aspirated through the exploring needle. Since there was no improvement in the condition of the patient, radical mastoidectomy was performed, and the patient made a prompt and complete recovery.

Nonsuppurative otogenous encephalitis is probably more frequent than is suspected. A focus of osteitis somewhere is indispensable for the production of encephalitic infection, and one can never be sure that otitis media is completely cured. Therefore, in a case of otogenous encephalitis or cerebral abscess, if improvement is not prompt after simple mastoidectomy or if after ample drainage of an abscess it tends to extend and the patient is not apyretic in a few days, radical mastoidectomy should be done at once.

DENNIS, San Diego, Calif. [ARCH. NEUROL. & PSYCHIAT.]

ANACHORETIC REACTION OF THE MIDDLE EAR: ITS REPERCUSSION IN THE PATHOGENESIS OF SUPPURATIVE OTITIS MEDIA. G. CORNELLI, Arch. ital. di otol. **47**:834 (Dec.) 1935.

Cornelli experimented on a group of guinea-pigs by giving them an injection of BCG vaccine in the middle ear and some time later (between ten days and three months) a subcutaneous injection in a distal limb of either the pus from otitis media in human beings or the cultures of a mixture of different bacteria, including Streptococcus mastitidis, as a bacterial indicator. Suppurative otitis media developed after the injection of pus. The bacteria subcutaneously injected made their appearance in the middle ear as early as two hours after the injection. In other groups of animals in the same condition (with relation to the previous intra-aural injection of the BCG vaccine) Str. mastitidis made its appearance in the middle ear more quickly when it was subcutaneously injected alone than when in symbiosis with Staphylococcus pyogenes-albus. In the latter case suppurative otitis media developed several days after the subcutaneous injection of the bacteria. The anachoretic reaction in the middle ear lasts about three months after the injection of the BCG vaccine, and is produced by phenomena of a biologic nature. The author points out the possibility of the development of suppurative otitis media by bacteria brought in the blood to the middle ear by a pathogenic mechanism similar to that noted in his experiments.

EDITOR'S ABSTRACT.

SIGNIFICANCE OF VASCULAR MURMURS FOR THE DEVELOPMENT OF NOISES IN THE EAR. H. TSUKAMOTO and M. SHINOMIYA, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **140**:247, 1936.

Tsukamoto and Shinomiya say that the physiologic noises in the ear, which can be heard only if external noises are excluded, are probably caused not by adequate stimulation or by periotic and entotic vascular noises but rather by inadequate stimulation of the cochlear terminal apparatus. If the external auditory meatus is closed by means of a dead substance, for instance, by a piece of ivory, three types of noise can be heard: (1) extremely low cardiac sounds, (2) weak, hissing noises that synchronize with the cardiac systole and (3) weak, almost constant buzzing and roaring noises.

The two latter types of noise are caused by the mechanical pressure exerted by the piece of ivory on the soft parts of the external meatus, but they are too weak to drown out the physiologic noises. The hissing noises that synchronize with the cardiac systole are due to arterial pressure, and the continuous buzzing and roaring noises are the result of pressure from arterioles, capillaries and veins. If the auditory meatus is closed with a finger, the noises elicited by vascular pressure in the ear become intensified by the noises caused by vascular pressure

in the finger, so that they drown out the physiologic noises, including the weak cardiac sounds. The development of the pathologic subjective auditory perceptions that occur in the presence of obstructing hard ceruminal plugs in persons with secreting catarrh of the middle ear or with adhesive processes in the course of otitis media is probably related to the sounds produced by vascular pressure. Moreover, it is possible that the noises caused by vascular pressure also play a part in the development of the periotic or entotic muscular noises in persons with disturbances in the sound conduction.

EDITOR'S ABSTRACT.

SUPPURATION OF THE PETROUS APEX. J. M. TATO and N. VON SOUBIRON, Monatschr. f. Ohrenh. **69**:1454 (Dec.) 1935.

Tato and von Soubiron report seven cases of disorder of the petrous apex. Then, after discussing the importance of Gradenigo's syndrome, the development and clinical manifestations of disease of the petro-apical pneumatic spaces and the roentgenologic aspects of petro-apicitis, they give their attention to the therapy. They think that in new cases without complication, without roentgenologic signs of carious erosion of the cellular trabeculae and without obliteration of the contour of the petrosa, the treatment should be limited to paracentesis, to opening with the chisel or to attico-antrotomy, depending on the condition of the middle ear and the duration of the disorder. In cases of suppuration of the petrosal apex with complications (meningitis and so on) and in cases in which there is roentgenologically demonstrable carious erosion in the apex, the surgical intervention should attack the apex directly, particularly if the pyramidal contours are interrupted or obliterated (usually a sign of extradural abscess) and if a radical operation has been made previously. The authors emphasize that the surgical methods for the treatment of disorders of the pyramidal apex are well developed and that their application is less dangerous for the patient than is an expectant attitude in the presence of a deep-seated suppurating focus. Moreover, it should be considered that in these operations it is always possible to preserve the labyrinth and in many instances the middle ear also.

In discussing the various surgical methods, the authors classify them into (1) the extrapyramidal method (with preservation of the middle ear) according to Streit, (2) the intrapyramidal method, with or without preservation of the labyrinth, and (3) the combination method of Unterberger (Streit's operation plus translabyrinthine operation). They think that the translabyrinthine method and the method suggested by Unterberger for apicitis are indicated only if simultaneously there exists labyrinthitis which developed secondarily from the perforation into the internal ear of a perilabyrinthine focus of pus. In other cases of suppuration of the pyramidal apex, the partial or total destruction of the internal ear is no longer justified, not only because it is always risky on account of the excretion of germs but because other well developed and relatively harmless methods are available.

EDITOR'S ABSTRACT.

PATHOGENESIS OF EARLY OTITIC MENINGITIS. O. BÉNESI, Monatschr. f. Ohrenh. **69**:1482 (Dec.) 1935.

Bénesi reports the history of an extremely acute otogenic meningitis in a man aged 52 who had never been subject to disease of the ear. Acute otitis media of the right ear developed within three days to severe mastoiditis that produced no clinical symptoms (no sensitivity to pressure or swelling at the mastoid). To be sure, within this short period a sinking of the posterior upper wall of the auditory meatus took place; however, on account of the severe general symptoms, which necessitated operation, this sinking was not noticed until a microscopic examination was made. The meningitis apparently developed almost simultaneously in the middle and in the posterior cranial fossa as the result of suppuration of cells in the extremely thin and partly dehiscent tegmen antri et tympani on the one hand and by way of the blood stream on the other hand. The infection of

the internal ear took place in a centrifugal direction through the internal auditory meatus. The cochlea showed signs of severe acute inflammation. If the process had lasted longer, inflammation of the peripheral vestibular apparatus would probably have developed by way of the annular ligament of the stapes (labyrinthitis centripetalis). The diagnosis of incipient meningitis was reached on the second day after the outbreak of the acute otitis on the basis of the extremely high temperature, the temporary mental confusion of the patient and the sensitivity to pressure on the homolateral bulbus. The author says that such cases should be treated by resorting at once to operation, in the course of which it is not sufficient to expose the dura in the region of the suppurated cells but it is necessary to expose both cranial fossae. He asserts that Neumann has used this method with good success in children who had mastoiditis suggestive of complications.

EDITOR'S ABSTRACT.

HISTOLOGIC FIXATION OF THE INTERNAL EAR. C. F. WERNER, Ztschr. f. Hals-, Nasen- u. Ohrenh. **39**:125, 1935.

Werner shows that the microscopic aspects of the internal ear are greatly influenced by various factors (temperature, degree of acidity and so on) involved in histologic fixation. He shows that a strictly uniform fixation with known effects is indispensable in histologic studies on the middle ear. The numerous fixation mixtures of potassium bichromate, solution of formaldehyde and glacial acetic acid differ considerably in quantitative composition and concentration (reduction of freezing point), while the hydrogen ion concentration fluctuates within narrow limits (determination three days after production). The fixation mixtures of the aforementioned constituents are subject to chemical changes, consisting chiefly in a reduction of bichromate into chromic compounds and in an oxidation of formaldehyde to formic acid. The changes become manifest in the well known discoloration and result in a reduction of the total concentration and of the hydrogen ion concentration. Higher temperatures accelerate these processes. The fixation mixtures (aforementioned constituents) can be produced in a definite quality only if, in addition to the exact specifications as to substances and mode of preparation, the age and the storage temperature are specified. The specifications formerly used were not sufficiently exact to permit a uniform technic of fixation.

EDITOR'S ABSTRACT.

EXPERIENCES WITH RADICAL OPERATION BY WAY OF THE AUDITORY CANAL. TRAMPNAU, Ztschr. f. Hals-, Nasen- u. Ohrenh. **39**:203, 1936.

Trampnau shows that the radical operation by way of the auditory canal is the method of choice for a large number of chronic suppurations of the middle ear which require surgical treatment, that is, for the uncomplicated and relatively circumscribed suppurations that develop on the basis of inhibition of the pneumatization in the antro-attic region and do not yield to conservative measures. Neither the typical radical operation nor its modifications has the advantages of the radical operation by way of the auditory canal. After the author had had some unfavorable experiences with the attico-antrotomy according to the method of Bárány and Streit, he studied the reports of the brothers Thies about the favorable results they obtained by the radical operation through the auditory canal and decided to try this method. At first he resorted to it only if a comparatively wide auditory meatus was present, but later he found that it could be used in other instances; and since then he has employed it in all cases in which there were no complications. In all cases in which he performed the operation through the auditory canal, the upper lateral wall of the meatus was severely involved, and in some cases the suppuration had persisted for years. In these cases it could be expected that the process extended to the antrum. The author points out that exposure of the antrum involves impairment of the auditory function only if a healthy incus is exposed; but of the forty-two cases in which he employed this

operation a healthy incus was found in only two, and unfortunately it could not be kept in position. However, in spite of this there was no further impairment of the hearing after the operation. The author explains why the incus is so frequently impaired. The operation disclosed a cholesteatoma in thirteen cases and caries in twenty-eight. With the exception of an instance of relapsing tubal suppuration and of three cases in which the condition was of rather short duration, the operation resulted in complete drying and epithelization in all cases. The author thinks that this superiority of the operation by way of the auditory canal over the other methods is probably due to the preservation of large portions of healthy bone that retains its normal periosteal covering. For a detailed report of all the advantages of this method he refers to the literature; but in addition to the favorable functional effect, he stresses that the radical operation through the auditory canal is easily tolerated, for it is no more trying for the patient than, for instance, the submucous resection of the nasal septum. EDITOR'S ABSTRACT.

ACTION OF QUININE ON THE ORGAN OF HEARING. K. WITTMAACK, Ztschr. f. Hals-, Nasen- u. Ohrenh. **39**:211, 1936.

Wittmaack studied the action of quinine on the organ of hearing chiefly on account of the undesirable effects on the hearing which are observed in the tropics, where quinine is used for the treatment of malaria, but also because this problem has theoretical interest. He shows that clinical observations alone do not solve this problem; so he resorted also to experiments on dogs. He demonstrates that the experimental anatomic studies of the action of quinine are not as valueless as might be assumed from a report by Seiferth but that the two most important symptoms—tinnitus aurium and hardness of hearing—can be satisfactorily explained on the basis of these studies. He differentiates two components of the action. One consists of a toxic impairment of the ganglion cells and of the pertaining nerve fibers, particularly in the cochlear neuron. Under certain conditions this toxic impairment may lead to an abolishment of the function of the ganglion cells and of the nerve fibers (cochlear degeneration), and it then results in the hardness of hearing that occurs after medication with quinine. The second component of the action consists in the elicitation of a hypotonic reaction in the labyrinth as a reflex process in the sympathetic nervous system and causes the tinnitus aurium that occurs during medication with quinine. EDITOR'S ABSTRACT.

Pharynx

A CASE OF EMPHYSEMA OF THE CHEEK AND NECK FOLLOWING TONSILLECTOMY. T. O. HOWIE, J. Laryng. & Otol. **51**:36 (Jan.) 1936.

Howie was encouraged to report this case of emphysema of the neck and cheek following tonsillectomy because he was unable to find a report of the condition in the literature and also because his senior colleagues, with whom he discussed it, had not theretofore met with this complication in their practice.

A woman aged 33 had suffered from widespread chronic fibrositis. She had frequent attacks of subacute tonsillitis, with the accumulation of semisolid débris in both supratonsillar recesses. Each attack was followed by tenderness and swelling of the tonsillar glands at the angle of the mandible. Examination revealed no evidence of disease in the nose or the paranasal sinuses. No adenoids were present. The anterior pillars of the fauces were markedly injected and showed a dull purplish red discoloration. The tonsils were small and buried, and the pharyngeal surfaces were rugged. Débris was easily expressed from both supratonsillar recesses. The tonsils were fixed and not easily rotated forward, and cocainization was necessary for a thorough examination. The tonsils were removed by dissection, with the area under local anesthesia. The anterior pillars were not markedly adherent, but some difficulty was experienced in separating the tonsils from the pharyngeal muscles, as if chronic fibrosis had taken place around the

capsule. This was most marked at the root of the tongue on the left side. Hemorrhage was minimal. On inspection of the empty tonsillar bed on the left side, the styloglossus muscle stood out as a cord in the lower part of the wound. A small piece of the fascia, just where the muscle entered the tongue, had been torn off over an area about ¼ by ½ inch (0.6 by 1.2 cm.), exposing the muscle fibers. On the afternoon of the same day there was a slight fulness of the left cheek, and an indefinite crepitation was felt over the mandibular border on the left side, at the anterior border of the masseter muscle. Next morning the swelling had extended down into the neck. The whole of this swollen area was crepitant and tender to touch, and the patient had severe pain on attempting to open the mouth. The emphysema was gradually absorbed, and the patient was able to go home seven days after the operation. There was no rise of temperature at any time following the operation. At the time of the operation the author was fortunate in noting the break in the pharyngeal aponeurosis. This gave the clue to the mechanism of the accident. It is well known that the swallowing of mucus and saliva after tonsillectomy is a laborious and exaggerated process. In this case the repeated acts of swallowing led to the forcing of air through the defect in the pharyngeal aponeurosis. It was fortunate that streptococci or other pathogenic bacteria did not enter the opened tissue planes and give rise to extensive and dangerous cellulitis. The defect was evidently rapidly sealed off, as the swelling began to be absorbed on the third day. EDITOR'S ABSTRACT.

A CASE OF MASSIVE TUBERCULOSIS OF THE TONSILS. BERNARD HUDSON and F. L. WOLLASTON, Tubercle **17**:30 (Oct.) 1935.

A woman of 21 had had frequent attacks of tonsillitis, with involvement of the lymphatic glands, during a period of two years. After two attacks of severe bronchitis a persistent cough developed, with loss of weight and a slight fever. Later the left lung became affected, and numerous tubercle bacilli were found in the sputum. Artificial pneumothorax was induced. This was following by rapid general improvement, but the sedimentation rate of the blood remained high. Following an acute attack of tonsillitis the tonsils were enucleated. The pathologic report on these organs was: Severe tuberculosis in the vicinity of the crypts, which has caused large caseous foci; numerous productive processes, with the development of epithelioid tubercles, scattered through the tonsils and marked with extensive giant cell formation.

From the history and pathologic observations it seems probable that the tonsils were the site of the primary lesions. In support of this theory is the rapidity with which the disease spread in the lungs, indicating a low resistance to tuberculosis, which would not likely have been the case if the infection was a reactivation of an old childhood focus in the tracheal glands. After removal of the tonsils the condition improved, and the sedimentation rate of the blood became normal.

EUGENE SMITH, Ogden, Utah. [AM. J. DIS. CHILD.]

CLINICAL ASPECTS AND THERAPY OF PERITONSILLAR SUPPURATIONS AND THEIR COMPLICATIONS. B. KECHT, Monatschr. f. Ohrenh. **69**:1333 (Nov.); 1423 (Dec.) 1935.

Kecht shows that for therapeutic reasons it is desirable to differentiate between primary and secondary tonsillogenic sepsis. The primary form develops from tonsillitis without an essential reaction on the part of the peritonsillar tissue; the secondary form develops from peritonsillitis. As far as the prognosis and the therapy are concerned, the primary form is less favorable than the secondary form. In peritonsillar suppuration it is important to differentiate between peritonsillar abscess and peritonsillar phlegmon. Abscesses can usually be cured by incision, whereas phlegmon requires tonsillectomy. In case of phlegmon incision may lead to complications. The author reports observations on 1,069 cases of

acute peritonsillitis in which surgical treatment was given in O. Mayer's department and on an almost equal number of cases in which an abscess was incised and cured in the ambulatorium of the clinic. Of the hospitalized patients, 156 underwent tonsillectomy; all others underwent incision. The author thinks that in cases of peritonsillar suppuration tonsillectomy should be done in the presence of the following conditions: (1) failure of the incision to reach the abscess or to effect a disappearance of the fever (deep posterior abscesses), (2) peritonsillar phlegmon, (3) edema of the larynx and of the floor of the mouth, (4) parotitis, (5) glandular swelling and gravitation abscesses, (6) sepsis with and without metastases, (7) spontaneous or postincisional hemorrhage and (8) in many cases, acute rheumatic disorder and nephritis. The author considers it unjustified to perform tonsillectomy in all cases of peritonsillar suppuration for the reason that the incision of a ripe peritonsillar abscess effects cure more quickly and is less trying for the patient than is tonsillectomy.

EDITOR'S ABSTRACT.

TONSILLOGENIC SEPSIS. G. HOFER and F. X. KOCH, Monatschr. f. Ohrenh. **69**:1409 (Dec.) 1935.

Hofer and Koch analyze a series of eight hundred and fifty-four cases of tonsillar disorder. In nineteen of these surgical intervention became necessary. Eleven patients were cured by simple tonsillectomy of the type performed for abscess; in three cases of cervical phlegmon without hematogenous sepsis cervical mediastinotomy was effective; in one case of gas phlegmon the condition terminated fatally as the result of arrosion of the superior thyroid artery and of the lingual artery. The other four cases of tonsillogenic sepsis, which are interesting from the point of view of the onset and the therapy, are reported in detail. Only one of the four patients who had severe attacks of chills could be saved, and in the case of this patient surgical treatment had been instituted after the first attack of chills. The other three patients were not hospitalized until after several attacks of chills had passed and after the general condition had already been greatly impaired. The authors stress that the surgical procedure for tonsillogenic sepsis can be successful only if it is instituted early, that is, at the earliest stage of propagation. With every attack of chills the prognosis becomes considerably more unfavorable, for a hematogenous dissemination involves particularly the pulmonary vessels, and pneumonia, with the formation of abscesses and with septic toxic impairment, is the result. The authors point out, further, that in many cases reported in the literature in which the condition is designated as sepsis it does not deserve this term. A high temperature alone is not sufficient for a diagnosis as sepsis as long as the other clinical symptoms, such as chills, small, flying and frequent pulse, great impairment of the general condition and acute metastases, are absent. If severe sepsis is confused with acute tonsillar infection which is accompanied by high temperature, it is impossible to get a clear insight into the value of the various surgical methods.

EDITOR'S ABSTRACT.

Nose

RHINOSCLEROMA, WITH THE REPORT OF A CASE. P. E. IRELAND, Canad. M. A. J. **34**:149 (Feb.) 1936.

A case of rhinoscleroma is reported from Canada, where the disease is rarely seen. The patient was born in Poland and went to Canada six years before the onset of the disease. When he was observed by Ireland, the disease had invaded the nose and spread as far down as the larynx. The diagnosis was verified by the pathologic examination and by the demonstration of Bacillus mucosus-capsulatus.

LEWIS, New York. [ARCH. DERMAT. & SYPH.]

A Case of Acute Unilateral Retro-Bulbar Neuritis Associated with Nasal-Sinus Disease. R. R. James, St. Clair Thomson, Lionel Colledge and H. G. Hodgson, Brit. J. Ophth. **20**:164 (March) 1936.

A man aged 72 had suppuration in the left maxillary sinus. Thomson drained the sinus through an opening in an empty molar socket. Two years later the rubber obturator had slipped into the cavity of the antrum. The left frontal sinus showed thickening of the mucosa and cloudiness. An endonasal operation was performed. There was occasional discharge of mucopus from the region of the left frontal sinus, and one year later vision in the left eye was rapidly reduced to perception only of hand movements. Examination by James showed the fundus to be normal. The visual field showed slight contraction in the upper nasal quadrant and a large central scotoma. A roentgenogram disclosed thickening of the lining membranes of all the sinuses of the left side and of the posterior ethmoid cells and sphenoid sinus of the right side. A pulsating spot in the neighborhood of the ostium of the sphenoid sinus was seen. The anterior wall of this sinus was cut away and the posterior ethmoid cells opened by Colledge. Although the operation was done within five days, no improvement in vision resulted. At the end of two months secondary atrophy was present.

It is inferred that the lesion of the optic nerve was due to direct spread of infection from a focus in the posterior ethmoid cells and sphenoid sinus, quite at the apex of the orbit. The authors believe the observation to be rare, as the great majority of patients with retrobulbar neuritis referred for examination prove to have disseminated sclerosis in an early stage or, sometimes, tobacco amblyopia.

W. Zentmayer. [Arch. Ophth.]

Anatomy of the Sinus Sphenoidalis. M. Sindoni, Arch. ital. di otol. **47**:864 (Dec.) 1935.

Sindoni discusses the anatomy of the sinus sphenoidalis, its relation to the nasopharynx and the sella turcica and its rôle in the development of pathologic conditions of the nasopharyngeal and sellar regions. His report is based on the results of 250 necropsies made on cadavers of persons who ranged in age from birth to old age.

Editor's Abstract.

Dextrose in the Therapy of Ozena. F. Sturm, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **140**:207, 1936.

Following the evaluation of several methods that have been recommended for the treatment of ozena, Sturm states that since sugar had been suggested for the treatment of wounds he decided to try a preparation of dextrose for the treatment of ozena and of simple atrophic rhinitis. The dextrose powder was blown into the nose at intervals of from one to three days, without previous removal of the crusts. After the efficacy of the preparation had been proved, the patients continued to treat themselves by means of an ointment of dextrose and hydrous wool fat or by means of a dextrose snuff powder. The author employed this treatment on twenty-five patients, twelve of whom had ozena, eleven atrophic rhinitis without fetor and two rhinitis sicca. For the majority of the patients, including all those with atrophic rhinitis, the treatment was successful in that one or two daily applications of dextrose ointment kept them well. The patients with ozena had neither crust formation nor fetor, but some had a noticeable amount of secretion. The sense of smell was not improved. Comparison with other therapeutic methods convinced the author that the treatment with dextrose is more effective. Other advantages are that it is simple, harmless and comparatively inexpensive.

Editor's Abstract.

Society Transactions

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

Nov. 2, 1936

IRA FRANK, M.D., *President*

WALTER H. THEOBALD, M.D., *Secretary*

OSTEOMYELITIS OF THE SPHENOID BONE: A REPORT OF TWO CASES. LAWRENCE J. LAWSON.

This paper will be published in full in a later issue of the ARCHIVES.

DISCUSSION

DR. T. C. GALLOWAY: From the appearance at the second operation, when a recent thrombus was noted in the sigmoid portion of the sinus and an organizing one toward the bulb, it can be assumed that the later symptoms were secondary to osteomyelitis of the sphenoid bone, as was the deep infection of the neck. It was difficult to explain the symptoms as they developed, and I doubt whether one could ever visualize such a pathologic condition early from the external signs. One can do little more in such a case than treat complications as they arise.

It must be doubted that osteomyelitis is nearly as rare as the small number of reported cases would indicate. Eagleton and others have shown that the mesenchymal nature of this bone makes it more vulnerable to certain types of infection, and this vulnerability must be an unsuspected source of serious complications in many cases.

DR. W. E. GROVE: That infection in the sphenoid bone outstrips infection in any of the other sinuses as the precursor of one of the complications Dr. Lawson mentioned—thrombosis of the cavernous sinus—is not to be wondered at for two reasons: First, the sphenoid lies in a strategic position, and it is a bone in which osteomyelitis can occur. That it does so occur was recognized by Boenninghaus, who compiled a large number of statistics, and also by Thompson. Thompson went so far as to say that of all infections of the cavernous sinuses he regarded infection of the sphenoid sinus as of the first rank, but he did not mention that the infection is probably largely osteomyelitic infection.

DR. HOWARD C. BALLENGER: There is one point I want to bring up, and that is the possibility of osteomyelitis of the sphenoid bone and the base of the skull in infants following an acute sinus infection. I had 1 such case in which osteomyelitis followed acute pansinusitis in which bilateral orbital abscesses developed. The abscesses were opened and drained, but the child died from pneumonia. At necropsy, in addition to the pathologic condition just mentioned, osteomyelitis of the base of the skull was found in which the osteomyelitic process had invaded the body of the sphenoid bone, with pus surrounding the cavernous sinus, but without involvement of the cavernous sinus itself. This case, among others, was reported in the *Illinois Medical Journal* under the title "Orbital Abscess"; hence it would not be found reported as a case of osteomyelitis of the base of the skull. I believe that if one would look through the literature under similar or related headings one would find reports of many other instances of osteomyelitis of the base of the skull that are buried under other headings.

DR. GEORGE E. SHAMBAUGH JR.: Dr. Lawson mentioned that drainage of the involved bone with a steel drill would not be effective. I wonder if it would

not be. In the petrous apex good results have been obtained from simple drainage of osteomyelitis, and the sphenoid bone is of the same type as the petrous apex.

DR. FRANCIS L. LEDERER: I may be able to answer Dr. Ballenger's question. Some time ago I reported a case and presented serial sections from the head of a 3 week old infant who died of an osteomyelitic process in the maxilla *(Surg., Gynec. & Obst.* **60**:645 [March] 1935). Changes might be noted in the sphenoid bone in a larger series of cases, but in this particular case no changes were noted. I am certain that this particular problem is not comparable to the pathologic condition in the petrous apex.

Dr. Shambaugh thinks that a bur can be put into the sphenoid bone to obtain drainage, but from a practical point of view I do not see how one can treat osteomyelitis in the sphenoid bone as one can the same condition in the petrous apex. The main concern as I see it is the lack of recognition of the entity. In citing the second case tonight Dr. Lawson is at an advantage because he can think about the case in retrospect. He might have done or thought differently. However, no symptoms were given in the report that would have centered attention on the disease in the sphenoid bone. In such cases one must differentiate thrombophlebitis from osteomyelitis per se, although I believe that one is concerned with two different entities in this particular problem.

DR. LAWRENCE J. LAWSON: I wish to thank the gentlemen for this discussion, and I wish that Dr. Shambaugh could prove his point. It would help one to do something for these unfortunate patients.

TREATMENT OF TINNITUS AURIUM BY THE INTRAVENOUS USE OF LOCAL ANESTHETIC AGENTS. DR. ROBERT B. LEWY (by invitation).

This paper will be published in full in a later issue of the ARCHIVES.

DISCUSSION

DR. BERNARD FANTUS (by invitation): I congratulate my young friend Dr. Lewy on his courage and industry and his intelligence and honesty in interpreting results. I was much interested in this work because not only does it seem to offer certain practical possibilities but it seems to be a step in the direction of an understanding of some of the effects of so important a drug as quinine, for instance. I should like to point out that quinine, like procaine and other drugs of the cocaine group, is a local anesthetic. There is, then, an identity of action on sensory nerve endings. The observation that Bárány made and Dr. Lewy has confirmed, seemed to show that there is also a common tendency to affect certain nerve centers. Just what this means leads one to rather interesting speculations. I believe that I was responsible for having Dr. Lewy try quinine in the treatment of tinnitus. On the face of it this may appear irrational, possibly a homeopathic type of therapy, but on the other hand it seemed extremely interesting to find out whether an intravenous dose of quinine might not be able to hit the very spot that an oral dose hits, but hits more gently, producing stimulation and hence tinnitus. When one comes to think of it, it is really a wonderful thing that quinine in a medicinal dose is able to hit this very spot in the system. There must be a definite affinity between the drug and this auditory mechanism. If there is such affinity, injecting this material intravenously and causing a sudden heaping up of it within the nerve mechanism may affect, and Dr. Lewy has shown that it does affect, the nerve mechanism. I believe that it is significant that some results have been obtained from the intravenous injection of quinine for tinnitus. One might expect that it would make the condition worse, but it did not do that. So it seems that here is an illustration of the general principle that a drug stimulates certain areas in small doses and depresses in large doses. In addition, the fact that a nerve tract which is irritable may be depressed by a dose that would irritate a normal nerve mechanism may also have something to do with the action and should encourage trying the oral use of quinine in those cases of tinnitus in which Dr. Lewy found that the condition responded to the intravenous injection. There may have been something wrong with the prepara-

tion of the solution of quinine, because much larger doses have been injected without untoward reaction. I should not like to see the use of quinine in tinnitus abandoned.

The fact that nupercaine seemed to give results much like those obtained with procaine hydrochloride is also interesting. Nupercaine is a quinine drug, and its chemistry therefore suggested that it might enable one to introduce with quinine a tremendous effect on these irritated nerve centers, and, as Dr. Lewy has shown, it does have this tendency. Every one is afraid of nupercaine, for it is a very toxic drug, and Dr. Lewy had courage to use it intravenously even though this use has been warned against.

I feel that Dr. Lewy has dug a trench where Bárány stuck a spade and discovered gold. I am glad that so representative a body of special students is here tonight, for it gives me the hope that the work will be continued and that it may be improved on. At present otologists are groping in the dark. If there is something in procaine that makes it anchor in the auditory mechanisms and the same thing is present in quinine, what is it? A chemist may be able to discover this and may hitch it to something else that may give further discoveries. I hope that the work will be continued and that its limitations will be more definitely set forth, and particularly do I hope that domestic harmony will be restored more frequently in these cases.

Dr. Louis K. Guggenheim: Dr. Lewy's presentation is interesting and important. Results of note have not yet been obtained, and the therapeutic use of this method must necessarily be limited for the present, but Dr. Lewy has dared to enter a field which is practically untouched—the field of tinnitus. Otologists do not know anything about tinnitus. They do not know where it originates. A few types of patient can be relieved of tinnitus. An occasional impaction of cerumen can be removed with relief of the symptom, and occasionally acute nonsuppurative otitis, following inflation, will cease to cause tinnitus, but in the vast majority of cases one is totally unable to help. Dr. Lewy is the first one, recently, whom I know of who has attempted research in this direction, and he deserves much credit.

As to quinine, I should think he would abandon it. Otologists have known for years that quinine is specifically toxic for the hearing mechanism, and Covel's work has shown that quinine, as well as the salicylates, produces a change of the mitochondria in cells of the spiral ganglion, the organ of Corti and the stria.

The paper gives me an opportunity to talk about something that I rather enjoy mentioning, and that is that persons really do not hear with their ears but through the ears with the brain, a thing that otologists sometimes forget. This question of tinnitus is difficult, for even when the end-organs are cut off it may not cease, as its site may be anywhere from the external canal to the cerebral cortex. (A lantern slide demonstration of the hearing mechanism from the drum membrane to the brain was given.)

The point I want to make is that one must learn to think in terms of end-organ and of brain and not alone of the temporal bone.

Dr. Ellison L. Ross: Those present will perhaps remember an article on tinnitus that was recently published by Dr. McNally of McGill University. I think he began the article well in citing some observations that have a bearing on the etiology. He stated that Frazier had considered that tinnitus is due to neuritis of the spiral ganglion of the cochlea, that Gray placed the causative lesion in the auditory nerve, that Crowe had observed tinnitus in only 25 per cent of the cases of nerve deafness proved by autopsy, that Coleman and Lyerly had sectioned ten auditory nerves and had cured the tinnitus in only 4 cases and that Dandy had sectioned the auditory nerve in 42 patients and tinnitus has disappeared in half of them. He also noted that of 351 patients with intracranial disease with no known aural trouble, 34 complained of tinnitus. Consequently one must think of the possibilities of tinnitus arising from the nerve ending, the nerve trunk, the medulla or the cerebral cortex.

I believe that the work of Dr. Lewy is valuable and interesting. It would also be of value to know the effect on tinnitus of similar injections of such preparations as a physiologic solution of sodium chloride, dextrose or arsphenamine. Possibly the injection of anything that would produce a slight shock would occasionally affect tinnitus. There are many treatments for tinnitus. In most of the cases the condition is little improved by any or all of them. However, otologists all have had the experience of getting good results with each method of treatment in isolated cases. The reason for these successes is rather obscure.

DR. R. W. GERARD: I am much interested in this paper and discussion from the purely physiologic standpoint. It seems clear that in many cases tinnitus cannot be peripheral in origin since it persists after the nerve is sectioned. On the other hand, I do not think that it follows that when tinnitus does cease after section it is necessarily peripheral in origin, since eliminating continuous auditory impulses might allow activity in the central elements to subside, as in other cases of rest to a slightly diseased structure.

The problem of maintained discharge of nerve cells interests physiologists today. They have assumed that central neurons are excited only when afferent impulses debouch on them. The evidence today is, I think, absolutely decisive that this is not the case, but rather that nerve cells may discharge without afferent impulses reaching them. The factors that control such "spontaneous" activity are being intensively studied, among others the influence of chemical constituents of the blood stream. It seems to me quite possible that in "central" tinnitus neurons in the auditory pathways, even in the auditory cortex, are exhibiting an excessive "spontaneous" activity. If that is the case, one might consider central tinnitus a sort of auditory epilepsy or auditory migraine.

The observations on animals and man that lend body to such a view are that neurons not only in the cortex but throughout the neuraxis exhibit a more or less continuous electrical oscillation. The main beat in man is 10 a second, in animals usually from 2 to 5. If discharges accompany these swings, especially under conditions of hyperirritability or overstimulation, as might easily occur in inflammation, for example, there is no great gap to bridge in understanding the continued discharges of cells involved in audition.

Regarding the interesting problems Dr. Lewy's work raises, two procedures occur to me which might yield valuable information. First, if these local anesthetics act on nerve cells, their effects may involve others besides auditory ones, and it might be possible to demonstrate changes in other maintained sensations. The long after-sensation of tickle or vibration or the duration of postrotational nystagmus might, for example, be shortened under their action. Second, and a much longer shot, if it should prove possible to record the electrical activity of the temporal lobe (through the intact scalp) in cases of tinnitus this would serve on the one hand as an objective measure of the presence of this symptom and of the effect of therapeutic attacks on it and, on the other hand, would go far toward testing the validity of such views concerning its pathogenesis as have been expressed in this brief discussion.

DR. JOSEPH C. BECK: From the clinical standpoint I am sure that any man who has had to deal with this condition will appreciate anything that may give relief to the patients who suffer from it. That is the distressing symptom which otologists are all trying to relieve. They are all acquainted with the drugs they are using by mouth. I was interested in the remarks of Dr. Fantus in regard to the drugs he advocated. In the introduction of the paper Dr. Lewy mentioned the name of Professor Bárány. Recently I have been reading about the wonderful results obtained in aural conditions, particularly deafness, with thyroxin by Prof. Albert Gray. Both these gentlemen made the contributions shortly before they died. While Dr. Lewy was reading his paper, I was wondering what I could do as a sort of antemortem spasm by recommending a drug that would work wonders in some malady of the ear, say for relief of severe, uncontrollable pain. Thus, relief from the three most distressing symptoms of disease of the ear would be provided.

The use of quinine is clear in my mind, and I am sure there are men here who have used this drug as a local anesthetic in the treatment of conditions of the throat, in tonsillectomy for instance. I have in mind a case in which I tried to do something for the relief of severe tinnitus by removing the tonsils, although the patient never had had tonsillitis. I was then using quinine and urea hydrochloride, extensively injected about the tonsil. The patient was free from tinnitus aurium for three years after that massive injection of quinine. Whether the quinine had anything to do with the disappearance of the tinnitus I do not know, but I do not think that it was removal of the tonsils that gave relief, because it never does in such severe forms.

Quinine, as was stated, is a drug that should be used carefully, particularly as an intravenous medication, when there is no difficulty with the hearing apparatus. I think that all those present remember the cases in which quinine was taken by pregnant women who had malaria. Taylor's work in which he reported cases in which mothers took quinine in large doses for malaria and it was transferred to the new-born, who subsequently showed nerve deafness, is well known. I should say, therefore, that in cases of severe tinnitus in which the hearing is little or not at all affected, one should not use quinine, even though one of the gentlemen who discussed the paper said that he would like to have it used further. It would not be my choice of drug.

I think that Dr. Lewy deserves a great deal of credit as a young man who has come before the society and given the members something they will all be thinking about.

Dr. Robert Sonnenschein: I think not only that Dr. Robert Lewy is to be congratulated on the fine paper which he has presented but also that one should felicitate his father, Dr. Alfred Lewy, on having presented so fine a son to the otologic world. The splendid manner in which he conducted his investigations and presented them augurs well for his future and for progress. I have had no direct experience with the use of these injections, but Dr. Samuel J. Pearlman has treated a few patients.

Dr. Irving Muskat: While Dr. Lewy was doing some of this work I had occasion at the Cook County Tuberculosis Hospital, which I visit regularly, to try this treatment on 10 patients with tinnitus picked at random. These were all patients with pulmonary tuberculosis, and as far as the tinnitus was concerned it included that with chronic suppurative otitis media as well as that with chronic adhesive catarrh and nerve deafness. I injected procaine hydrochloride, from 5 to 10 cc. of solution, depending on what I thought the patient would stand. The patients were all gone over thoroughly as to functional tests, and in no case did I observe any amelioration of the tinnitus at the time of injection or when checking up a week later. In not one case was the tinnitus decreased, but in two cases it was increased. There was no change in the result of functional tests after these injections of procaine hydrochloride. I did not continue the experiments on any other patients who were waiting their turn, because I was discouraged with the results.

At about the same time a patient was sent to me with marked tinnitus of long standing, associated with rather severe and chronic cervical osteo-arthritis. I gave that patient two injections of 10 cc. of a solution of procaine hydrochloride a week apart, and she experienced no amelioration of her tinnitus. She refused to have any more injections. No ill effects were apparent from such treatment, however.

I simply report these findings as one who has tried these experiments and hope that further study may be done in those clinics in which there is much clinical material.

Dr. George E. Shambaugh Jr.: I was under the impression that procaine hydrochloride is a dangerous drug to use intravenously in some cases. I understand that it is sometimes accidentally introduced into the vein in general surgical procedures and that the results are bad. The same thing happens with cocaine in susceptible patients. No doubt there are idiosyncrasies to these drugs.

DR. HARRY L. POLLOCK: I wish to congratulate Dr. Lewy on this fine piece of experimental work and to state that Bárány was not the first to suggest this idea. Ten years ago, in 1926, two brothers, F. and W. Hueneke, employed impletol (procaine hydrochloride with the addition of caffeine). They employed the drug in about 500 cases not for tinnitus alone but for some types of headache and circulatory disturbances. These intravenous injections were given often, sometimes daily, without any fatalities, but occasionally they saw unpleasant reactions somewhat similar to those reported by Dr. Lewy. In 1928 Z. Polti employed a 1 per cent solution of procaine hydrochloride in a 5 per cent solution of magnesium sulfate for tinnitus, with similar beneficial results. Patients obtained relief lasting from twenty minutes to several days. Occasionally relief was obtained for one year, but of course these cases were exceptional. After recurrence of the tinnitus similar good results were obtained by a new course of treatment, demonstrating that there is no increased tolerance to the drug.

DR. ROBERT B. LEWY: I greatly appreciate the discussion. Answering Dr. Shambaugh, I realize that the biggest hurdle I have to get over is the idea that procaine hydrochloride in suitable dosage is not dangerous. Bárány in his original article expressed the belief that the danger attributed to procaine hydrochloride administered intravenously is from some other source. May I suggest epinephrine? When procaine hydrochloride is employed, it is usually used with epinephrine, and bad results may be due to that. I have always felt that "the proof of the pudding is in the eating," and I have given over 300 injections with no bad results.

I do not wish to exaggerate the beneficial results obtained in dealing with nerve deafness. Despite the fact that there were 3 failures in nerve deafness, there was a sizable group in which the only relief was a change in the pitch of the tinnitus.

My paper would not be complete without remarking, as Dr. Beck did, the advantages of picking a good problem. For this I can take no credit, for Dr. Alfred Lewy dropped the problem in my lap.

I wish to thank Dr. Fantus, for without his solutions, suggestions and support I could have done nothing. If a trench has been dug, it has been dug with a spade. I should like to see what the steam shovels can do.

A BRIEF CONSIDERATION OF THE HISTORY OF THE DEVELOPMENT OF MASTOIDECTOMY. DR. ROBERT SONNENSCHEIN.

Although really an otologic subject, mastoidectomy was developed to a large degree by the work of a number of general surgeons. It seems both proper and interesting to mention some of the factors regarding various developments which either antedated the actual surgical intervention in the mastoid or had no direct bearing on it but are important milestones in the history of otology. Among these items are the development of the aural speculum, the first use of the eustachian catheter and the first paracentesis of the drum membrane (myringotomy).

A layman, the postmaster of Versailles, Edme-Gilles Guyot (1706-1786), endeavored to cure himself of impaired hearing by inflation of the tympanum by means of an instrument introduced through the mouth in the vicinity of the orifice of the eustachian tube. Paracentesis of the drum membrane (myringotomy) was apparently first carried out by the great English surgeon Sir Astley Cooper (1768-1841). He observed several cases in which the drum membrane was perforated or destroyed without causing serious impairment of hearing, and therefore thought it probable that deafness due to obstruction of the eustachian tube might be relieved by puncturing the tympanic membrane.

The first successful operation for suppurative disease of the mastoid was performed in 1736 by Jean Louis Petit (1674-1750 ?), who was the foremost surgeon of his day. Owing to various factors, not the least of which was the fatal result of the mastoidectomy performed on Baron Dr. von Berger, physician to the King of Denmark, the operation fell into disrepute. Two of the great English aural surgeons, William R. Wilde (1815-1876) and Joseph Toynbee (1815-1866), were

among those who also expressed themselves adversely with regard to the opening of the mastoid process. It was due largely to Anton F. von Troeltsch (1829-1890) that the German surgeons were stimulated to further work with reference to the mastoid operation. Herman Schwartze (1837-1910) did a tremendous amount of work in connection with operation on acute mastoiditis and did the first operation of this kind in Germany in 1863. The first mastoidectomy performed in the United States was done by Lawrence Turnbull (1821-1900). He was born in England but lived most of his life in Philadelphia and there did most of his work. The first mastoidectomy performed in England was done by James Hinton (1822-1875) in 1868 and was reported in an address before the Royal Medical and Chirurgical Society in London.

If there were intracranial complications in cases of acute involvement or if chronic otitis media was present, it was found necessary to develop a more radical operation, namely, the radical mastoidectomy. This procedure was really the work of two general surgeons, Ernst Kuester (1838-1930) and Ernst von Bergmann (1836-1907), both of whom presented the subject before the German Medical Society in 1888 and 1889. While Kuester was the first to remove the outer bony wall of the attic, by their combined procedures the various cavities in the temporal bone, namely, the antrum, attic, middle ear and external canal, were converted into one cavity. E. Zoufal (1837-1918) advocated opening the mastoid bone from within outward. After elevating the skin and periosteum from the posterior and superior walls of the bony canal, he first entered the tympanic cavity, then the attic, and finally the antrum. Later various types of plastic flaps, skin grafting, etc., were developed, but the essential principles of the radical mastoid operation are continued to the present time.

Book Reviews

Modern Treatment of Diseases of the Respiratory System. By A. Lisle Punch, M.B., Senior Physician, Royal Northern Hospital, Physician Brompton Hospital for Diseases of the Chest, and F. A. Knott, M.D., D.P.H., Director, Bacteriological Department and Lecturer in Bacteriology to the Medical and Dental Schools, Guy's Hospital, Reader of Pathology, University of London. Price, $5.00. Pp. 295, with 96 plates and 31 figures in the text. Philadelphia: P. Blakiston's Son & Co., Inc., 1936.

This is a small volume, which covers diseases of the lungs and bronchi, written from the point of view of the internist. There are numerous pictures, chiefly roentgenograms, illustrating the various conditions. Of interest to the otolaryngologist is the almost complete lack of reference to bronchoscopy in the sections on the diagnosis and treatment of the conditions mentioned. Bronchoscopic treatment of bronchiectasis is not recommended. Bronchoscopic diagnosis of carcinoma is given only a single paragraph. For the injection of iodized poppy-seed oil the cricothyroid route, the injection being made through the cricothyroid membrane with a hypodermic syringe, is recommended rather than the oral route.

The association of purulent bronchitis with bronchiectasis is not even mentioned, nor is anything said of the importance of clearing up an associated sinus infection in the treatment of bronchiectasis. In the section on the treatment of bronchial asthma, the association of a pathologic condition of the nose is mentioned in only a single paragraph, and the statement is made that nasal sepsis is not a primary cause of the asthma.

The subjects covered are the common cold, laryngitis, bronchitis, bronchiectasis, bronchial asthma, hay fever, whooping cough, pneumonia and its complications, intrathoracic tumor, fungous and dust diseases and pulmonary tuberculosis.

Directory of Otolaryngologic Societies *

FOREIGN

COLLEGIUM OTO-RHINO-LARYNGOLOGICUM AMICITIÆ SACRUM

President: Prof. Gunnar Holmgren, Karolinska Mediko-Kirurgiska Institutet, Stockholm, Sweden.
Secretary: Prof. Dr. C. E. Benjamins, Verlengde Heereweg, 143 Groningen, The Netherlands.

NATIONAL

AMERICAN MEDICAL ASSOCIATION, SCIENTIFIC ASSEMBLY, SECTION ON LARYNGOLOGY, OTOLOGY AND RHINOLOGY

Chairman: Dr. Robert F. Ridpath, 1737 Chestnut St., Philadelphia.
Secretary: Dr. Gordon B. New, Mayo Clinic, Rochester, Minn.
Place: Atlantic City, N. J. Time: June 7-11, 1937.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Frank E. Burch, 408 Peter St., St. Paul.
Executive Secretary: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: Detroit.

AMERICAN BRONCHOSCOPIC SOCIETY

President: Dr. Joseph C. Beck, 185 N. Wabash Ave., Chicago.
Secretary: Dr. Lyman Richards, 319 Longwood Ave., Boston.

AMERICAN LARYNGOLOGICAL ASSOCIATION

President: Dr. W. B. Chamberlain, 10515 Carnegie Ave., Cleveland.
Secretary: Dr. James A. Babbitt, 1912 Spruce St., Philadelphia.

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

President: Dr. George M. Coates, 1721 Pine St., Philadelphia.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester, N. Y.
Place: Hotel Traymore, Atlantic City, N. J. Time: June 3, 4 and 5, 1937.

SECTIONS:

Eastern.—Chairman: Dr. D. C. Jarvis, Quarry Bank Bldg., Barre, Vt.
Place: Boston. Time: Jan. 7, 1937.
Southern.—Chairman: Dr. Charles D. Blassingame, P. & S. Bldg., Memphis, Tenn.
Place: Memphis, Tenn. Time: Jan. 13, 1937.
Middle.—Chairman: Dr. Alfred Lewy, 25 E. Washington St., Chicago.
Place: Chicago. Time: Jan. 11, 1937.
Mid-Western: Dr. Frederick A. Figi, 436 Tenth Ave., Rochester, Minn.
Place: Chicago. Time: Jan. 11, 1937.
Western.—Chairman: Dr. David R. Higbee, 3245 Fourth Ave., San Diego, Calif.
Place: San Diego, Calif. Time: Jan. 30 and 31, 1937.

AMERICAN OTOLOGICAL SOCIETY

President: Dr. Edmund Prince Fowler, 140 E. 54th St., New York.
Secretary: Dr. Thomas J. Harris, 104 E. 40th St., New York.

---

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.